# POWER

A McGRAW-HILL PUBLICATION—ESTABLISHED 1884
ELY C. HUTCHINSON, *Editor*

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# Mass Production

A MAN by the name of Jim Brady, not Diamond Jim, but another, had a machine shop over in Brooklyn, and among the other devices which he successfully turned out was the little oscillating engine that, mounted upon a boiler with an alcohol lamp, has brought delight to so many an embryo engineer.

There came one evening to the summer resort at which Jim was staying the swelled-up offspring of a leading small-town family. He joined the after-dinner group upon the piazza and before the cigars had burned halfway down he had let it be known that his were the real people of his town. His father was president of the bank and he himself headed up the leading industry, an engine and machine works.

And he went on to tell with prideful satisfaction of the size and importance of his company, the magnitude and modernness of his shops, the number of men in his employ, the number of orders on his books, etc.

"Yes Sir! I turned out last year over two hundred engines, and this year I am going to beat that by twenty per cent."

The awed silence that ensued was broken by Jim, who ventured the remark that he was in the engine business himself.

"That so?" asked the newcomer. "What kind of an engine do you make?"

"Small high speeds."

"And your name?"

"Brady. Jim Brady."

"Got many of your engines out? I never heard of it."

"Yes, quite a few."

"What was your turnout last year if it's a fair question?"

"I don't know just. Something around nineteen or twenty thousand."

"Nineteen or twenty thousand engines—in one year?"

"Oh yes," Jim rejoined dryly. "And the boilers too."

# EDITORIALS

## Power Plant Hermits

MANAGERS of industrial plants seldom give their power engineers the opportunity to visit other power houses and to meet with other engineers. This policy of always keeping the engineer on the job, of loading him with other duties, such as general plant maintenance, eventually reacts to the detriment of the power house and the engineer.

By visiting other plants and attending society meetings the engineer may compare his operating and maintenance methods with those practiced by others. He can pick out the best of what the other fellow does and apply them to his own conditions. Improved operation should result without the necessity of extensive and expensive changes in plant equipment.

The consulting engineer in the power field has the peculiar advantage of being able to visit practically any power plant he may desire and to obtain a large amount of operating information. Such experience and information when intelligently applied to plant betterment will frequently yield savings similar to those described in the article on the Bridgeport plant in this number.

The management that provides opportunities for its power engineer to visit other plants will probably have a better operated and maintained power house. Those who now find their power costs higher than the published costs of other similar plants, can profit by securing and acting upon the advice of a competent power consultant.

## Watch the Losses in Distribution and Application

REDUCTION in power costs can be made beyond the bus bars as well as in generation. It is short-sighted economy not to follow the heat unit from the coal pile to the finished product. The distribution system and power applications should receive as careful consideration as is given the power plant. An improperly designed distribution system will be a continuous source of unnecessary power losses that must be supplied by burning fuel. Motors not suited to, or too large for, their applications also cause power losses. For instance, a slow-speed induction motor may require double the current of a synchronous machine. In addition, the efficiency of the synchronous machine will be better than that of the slow-speed induction motor.

Well-designed and properly installed distribution systems and power applications will do much toward keeping down power losses. But, like the generating station, they require attention if avoidable losses are to be kept at a minimum. Insulation in poor condition, equipment and shafting out of line, and other faults, may result in large power losses. The ten or fifteen per cent loss that may exist outside the plant should not be overlooked when chasing the last fraction of one per cent in the power plant.

## Boiler, Economizer and Air Heater Surfaces

A RECENT article by Linn Helander in *Power* discussed the very important question of how the heating surfaces in a modern boiler plant should be divided between boiler, economizer, and air heater. As the author points out, there are many factors to be considered, but in the limited space at his disposal he was unable to discuss all of them in an exhaustive manner.

Formerly boilers were built along certain standard lines to absorb 70 to 80 per cent of the heat in the fuel. Economizers or air heaters were added to absorb a portion of the heat remaining in the flue gases when savings warranted the use of such apparatus. The introduction of water-cooled furnace walls added more radiant-heat-absorbing surfaces to boilers.

There does not seem to be any agreement at the present time among boiler designers as to the relative areas of convection and radiant-heat-absorbing surfaces

for best performance considering first cost and efficiency. There is a tendency to reduce the area of the high-cost convection surfaces and to pass hotter flue gases to less expensive economizer surface of the steaming type. This will reduce first cost with no sacrifice in efficiency. Modern furnaces require some air preheat to secure best operation, and feed water can be economically heated by bled steam. This further complicates the problem.

These considerations indicate that much can still be said regarding the division of these surfaces. Actual operating performance and costs of various arrangements would be valuable data. Further discussions similar to Mr. Helander's will be welcome. Engineers can only reach definite conclusions in regard to the division of boiler, economizer, and air heater surface when all facts are made available for analysis.

## Draft Losses Through Boilers

A SEARCH through current texts on power plant design reveals a miscellaneous collection of data on draft losses through boilers, little of which is of any service to an engineer wishing to prepare estimates. In most cases only very general statements of a vague nature are presented. Reports of boiler tests appearing in these texts and in technical journals provide reliable data on certain specific installations. The engineer who has much of such estimating to do, collects and analyzes such data. This analysis takes time and effort, and many busy men cannot assemble such material. They must therefore either fall back on certain empirical rules for draft losses or make random guesses.

It is obvious that the draft loss varies with the particular boiler under consideration. Its type, arrangement of baffles, number of passes, tube spacing, together with rate of driving, all affect the draft losses that result from the flow of given weights of gases through the boiler. Boiler manufacturers have data on which they base estimates of performance which are approximated in practice. These data are generally not made public in their trade literature.

It would seem possible to secure such data on various types and sizes of boilers, each operating over a range of load, and to assemble this for analysis and consideration. Some general curves or equations might be derived that would be representative of each specific type of boiler and of each common method of baffling. Such data would not only be helpful to students in engineering colleges, but would also be of value to designing engineers. Possibly some student may select this for a thesis subject, or some junior member of a national society may submit such a study in competition for one of the annual prizes.

The profession needs such data. Who will be the first to supply them?

## A Code for Welded Boilers

A PROPOSED code for welding power boiler shells and drums by the fusion process has been made public by the A.S.M.E. Boiler Code Committee. It is published in full in the March issue of *Mechanical Engineering,* and in this number of *Power.*

The introductory paragraph makes clear the status of this code and the committee's reason for publishing it at this time. It is not in any sense a final code merely awaiting a few minor changes before official approval. This proposal is concrete and detailed in its provisions, not because engineering opinion is fully crystallized on the subject of boiler welding, but rather in order to precipitate such crystallization.

The use of welding has been extended widely in many fields during the last few years, although most of these applications do not carry the hazard which attaches to the pressure sections of steam boilers. However, this greater use of welding does mean a larger number of workmen familiar with welding practice from which may be selected those properly qualified to handle boiler work.

The code committee properly takes the position that boiler welding will be made legal only as fast as and as far as adequate safeguards can be set up to protect the user. With this stand the leaders of the welding industry, represented by the committees of the American Welding Society, are in full accord. They realize that the welding of high-pressure boiler drums and shells must not be approached in a "half-baked" manner. These men have a real concern for the public welfare, and a due appreciation of the possibility of a setback to the rapidly advancing welding industry if promiscuous boiler welding, inadequately guarded, is permitted. Hence this tentative code has been brought out at this time. It is largely their work.

The time for practical discussion is now—not after an official code has been adopted. Those interested are urged to give careful scrutiny to the proposed code and put their opinions on record without delay.

▼

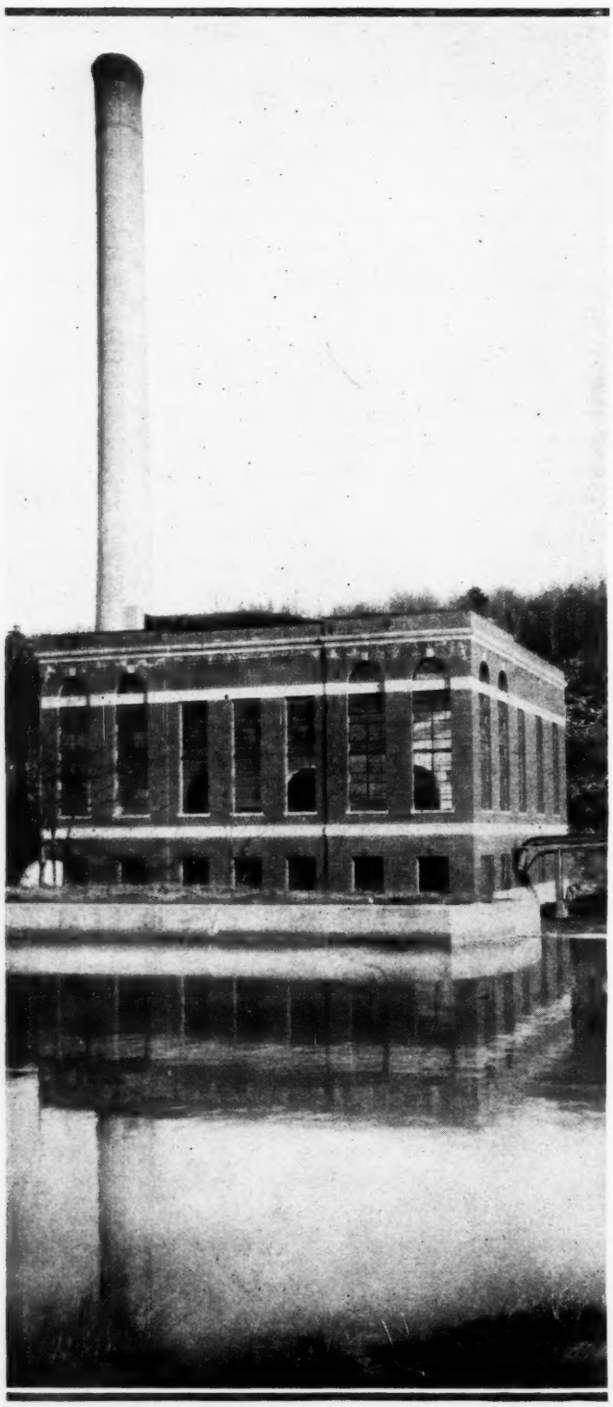
## POWER *Stands for . . .*

1. Making Power When It Should Be Made
2. Buying Power When It Should Be Bought
3. Cheaper Power Through Modern Equipment
4. Easier Financing of Equipment Purchases
5. Better Use of Byproduct Heat and Power
6. Operating Methods That Save Money
7. Less Waste in Transmission and Application
8. Prevention of Smoke, Within Reason

▼

# CROCKER, BURBANK STATION...An

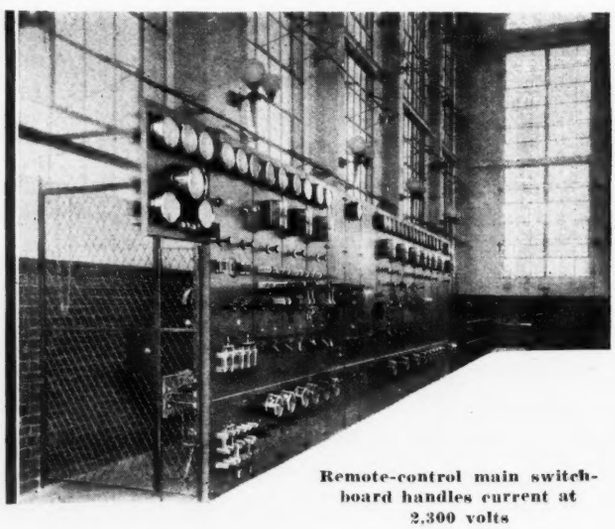
**Three paper mills in Fitchburg, Mass., pool supply of steam and byproduct power in single ultra-modern plant. Pressure drop from 400 lb. to 35 lb. in efficient units, with outlet for all excess byproduct power generated, insures effective utilization of fuel energy**



Balance—of energy forms, of equipment, of architectural proportions—is the keynote of the design

AN OUTSTANDING achievement in the field of industrial power was the completion, last May, of the Crocker, Burbank central steam plant in Fitchburg, Mass. Bits of data regarding this plant have been published from time to time, but no complete description has been authorized by the owners, who desired first to complete the electrification of the mills served and establish the plant on an operating basis. This has now been accomplished, and the management, in co-operation with the consulting engineers, has made available to *Power* the information on which this article is based.

This plant is significant in at least four respects, any one of which would command the attention of power engineers everywhere. In the first place, it stands as a symbol of a wave of modernization that is sweeping over New England. That historic section, the nucleus from



Remote-control main switchboard handles current at 2,300 volts

By P. W. SWAIN
Associate Editor of *Power*

# Outstanding Example of Balanced Design

which has grown today's America, is revamping its old machinery to meet the tempo of a new and faster-moving industrial age.

Secondly, the Crocker, Burbank station stands out as the year's most interesting example of a private "central station."

A third claim for attention is found in the steam pressure of 400 lb., although this distinction must be shared with a fair number of other plants, particularly in the paper and textile industries.

But the greatest significance of this plant is its extraordinary utilization of byproduct power, made possible by a utility connection which absorbs all the power generated in excess of the mill requirements.

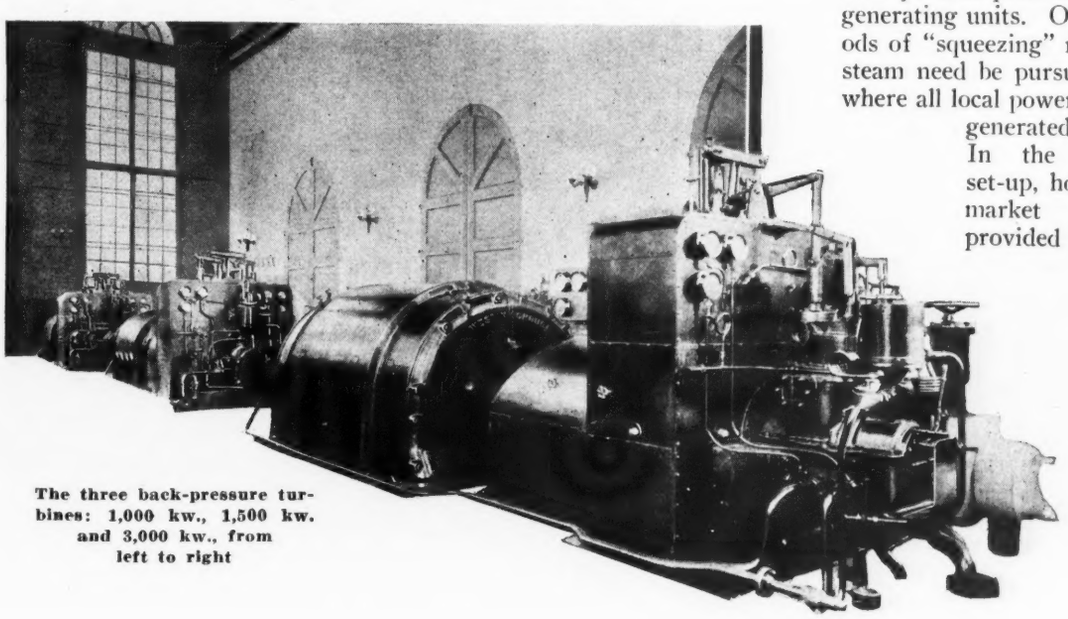
Before going into the details of the design it will be well to picture the setting for this development and outline the main features of the plant.

Crocker, Burbank & Company operate nine paper mills, all situated in Fitchburg, a city of 50,000 population about fifty miles west of Boston. Three of the mills, known as Nos. 6, 7, and 9, closely placed along the Nashua River, take all their steam requirements from the new plant. Formerly they were served by individual power plants equipped with hand-fired return-tubular boilers, which supplied steam to reciprocating engines driving the paper machines and exhausting to the driers. Other power was purchased.

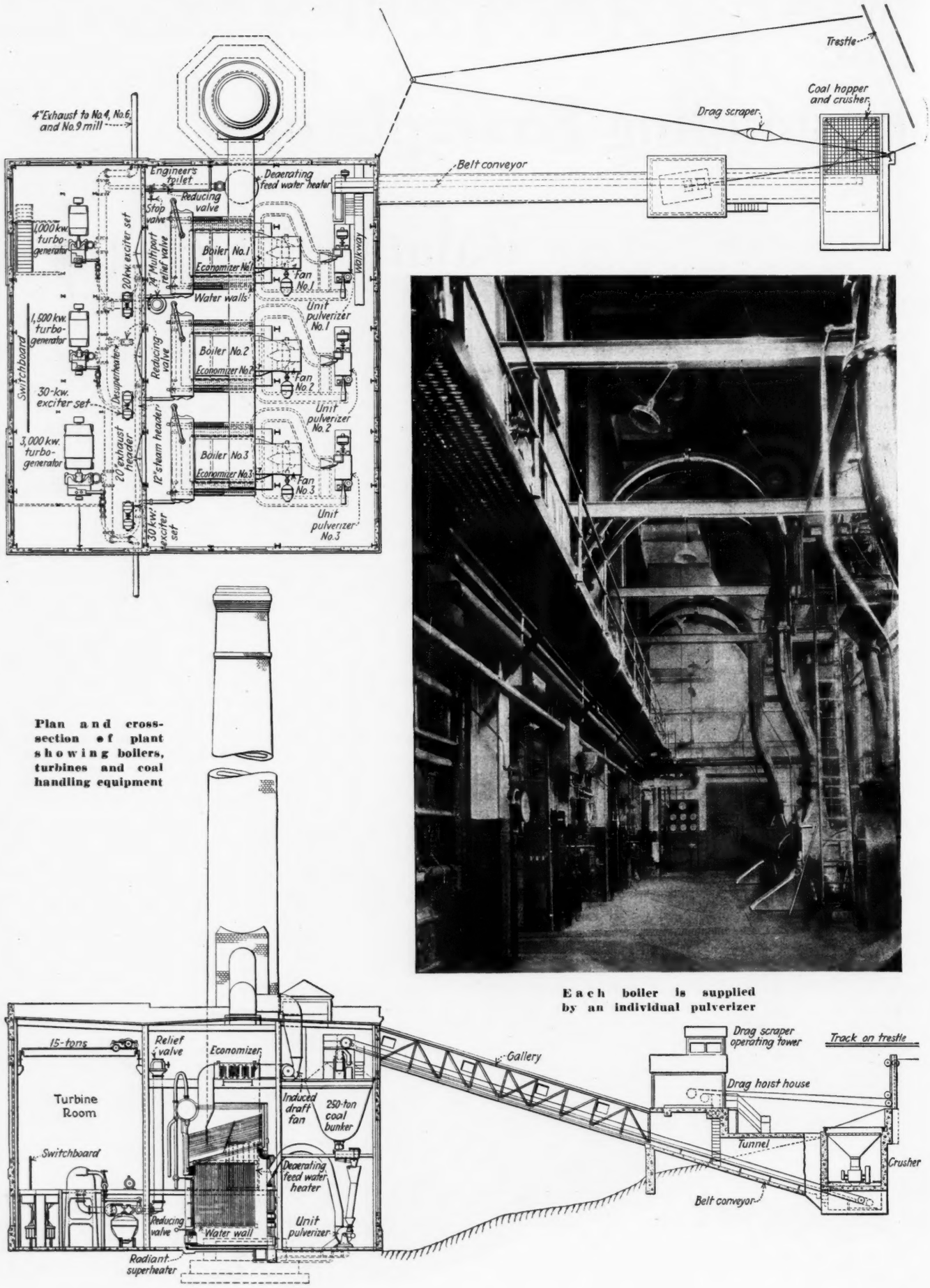
The individual power plants have now been dismantled and the paper machines electrified. The new central steam plant, using half the labor and far less fuel than the old individual boiler rooms, supplies all power for paper-machine drive, all process steam and—indirectly—a considerable part of the power used for general machine drive and lighting.

This last statement calls for further elucidation. Actually, power, other than that for paper machine drive, is taken from the lines of the New England Power Company. But, at the same time, the turbines of the Crocker, Burbank steam plant are pumping energy into the lines of the power company. All process steam passes through these turbines, and all electricity produced in excess of the paper-machine requirements is delivered to the power lines. There is thus a complete utilization of byproduct power. The method of tie-in, dictated by the peculiar requirements of paper mills, will be explained more fully later.

Provision for absorption of power at all times had a definite effect on the plant design. In any plant there are three ways to increase the amount of byproduct power obtainable from a given flow of process steam. They are: Increased boiler pressure, lowered process pressure, and more efficient generating units. Ordinarily, these methods of "squeezing" more power from the steam need be pursued only to the point where all local power requirements can be generated as a byproduct. In the Crocker, Burbank set-up, however, the unlimited market for excess power provided by a large group of



**The three back-pressure turbines: 1,000 kw., 1,500 kw. and 3,000 kw., from left to right**




**Plan and cross-section of plant showing boilers, turbines and coal handling equipment**



**Each boiler is supplied by an individual pulverizer**

mills tied to one electric feeder changes all this and makes it definitely worth while to extract as much power from the steam as possible. For that reason the boiler pressure was carried up to 400 lb. and the process pressure lowered to 35 lb. (gage).

Inside and out, the Crocker, Burbank plant has the usual appearance of a thoroughly modern central station. Only the condensing equipment—emblem of heat waste—is lacking. A white-walled turbine room is flooded with light from eleven windows, each 25 ft. high and 6 ft. wide.

In the boiler room the three 4,893-sq.ft. water-tube boilers are fired with pulverized coal, weighed to each pulverizer.

Other features are water-cooled furnace walls, radiant superheaters, economizers and induced-draft fans, and the use of 2,200-volt current for all but the smallest electrically driven auxiliaries. Incidentally, except for a spare feed pump drive and a few odd duplex pumps all auxiliaries are motor-driven.

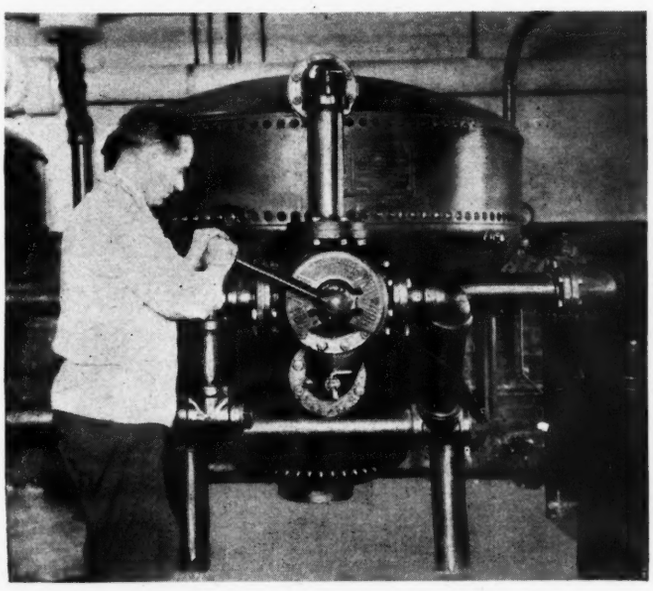
The outdoor steam-transmission line, carrying process steam at 35 lb., runs 1,000 ft. upstream to mill No. 7 and 2,000 ft. downstream to mills No. 6 and 9. The steam line to No. 7 mill is 12 in., welded and insulated with 85 per cent magnesia 3 in. thick (two layers). It is weatherproofed with building and roofing paper. To No. 6 the line is 14 in., and from No. 6 to No. 9 it is 10 in. These lines are constructed and protected in the same way as the line to No. 7.

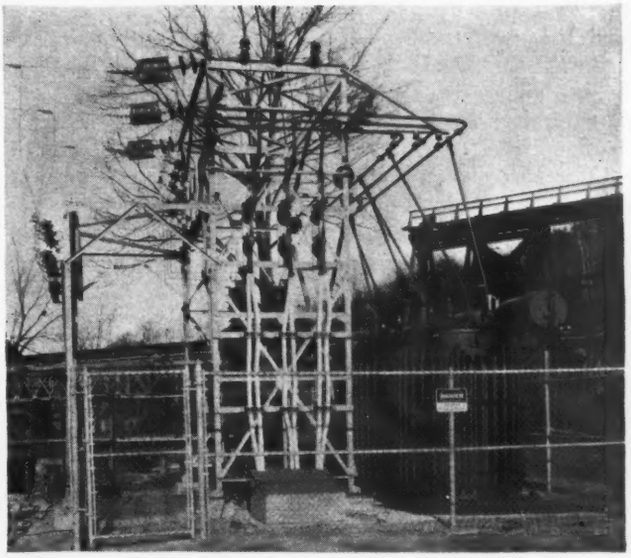
For the operation of paper machines exclusively 60-cycle current, 2,200 volts, 3 phase, is carried underground to mills 6 and 7 in three-conductor, 4/0 cables rated for 5,000 volts. The insulating and protecting layers are as follows: $\frac{5}{32}$-in. Kerite, tape, jute bedding, two layers steel ribbon, jute serving.

Many details of the equipment are given in the table at the end of this article, but the main features may now be reviewed, following through the cycles of fuel, ash, air, steam and electricity.

Pocahontas coal is used here, as in many other New England plants, where long hauls pile up freight charges and make the lower-grade coals uneconomical. This fuel, as fired, averages 14,200 B.t.u. per pound and 5½ per cent ash. The moisture as received averages 4 per cent.

**Two conical sand filters remove suspended matter from the make up water before chemical treatment**





**In the yard is a 2,200 to 13,000-volt switching and transformer station**

Dumped to storage beneath a railroad trestle, coal is reclaimed by drag and delivered by belt conveyor, magnetic separator, crusher and distributing belt with tripper to a 250-ton suspended steel bunker. Thence it passes via scales spouts to the three unit pulverizers supplying the three boilers. Each pulverizer is driven by a 75-hp. 2,200-volt motor and feeds two burners discharging obliquely downward from the top of the furnace. Preheated primary air is drawn to the pulverizer from the hollow furnace bottom.

The boilers are of the horizontal, cross-drum water-tube type with a number of features that are unusual in industrial plant practice. In addition to 4,893 sq.ft. of ordinary water heating surface, each boiler has 368 sq.ft. of water-wall heating surface in the two side walls. The back wall is also cooled, but by a 114-sq.ft. radiant superheater which raises the temperature of the 400-lb. steam to an outlet temperature of 645 deg. F. This temperature insures steam slightly superheated at the turbine exhaust pressure of 35 lb. gage.

The furnace bottom, also, is cooled, the floor consisting of carborundum blocks laid over cast iron boxes through which primary combustion air for the pulverizers is drawn.

Normal steaming capacity is 44,000 lb. per hour per boiler, and the maximum for short periods about 60,000 lb. With a furnace volume of 3,450 cu.ft., and a unit efficiency of 82 per cent, this gives a maximum combustion rate of 23,800 B.t.u. per cubic foot per hour.

Each boiler is provided with a 2,500-sq.ft. economizer placed horizontally to conserve space. Between the economizer and the breeching is an induced-draft fan with a capacity of 36,000 cu.ft. per minute at 6.25-in. static pressure. Under normal operating conditions the economizer raises the feed temperature from 214 to 308 deg. F. and cools the gases from 615 to 338 degrees.

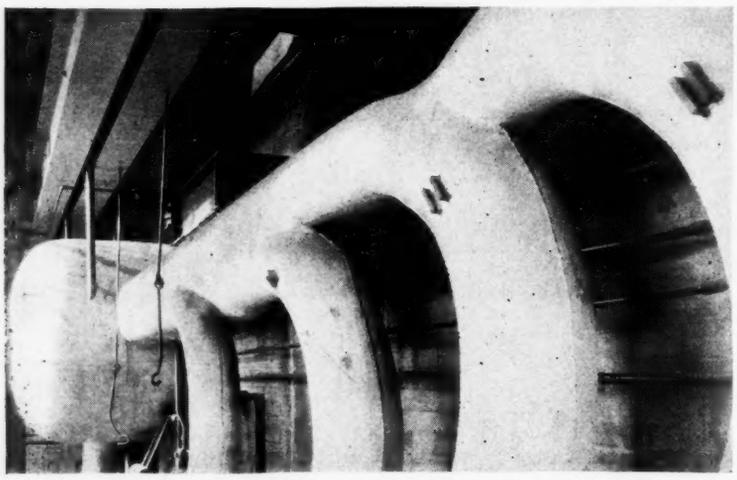
Ash that collects in the bottom of the furnaces (no water screens are used) is removed by a vacuum steam-jet system and delivered to an outside concrete bunker, elevated for discharge to motor trucks.

Complete oil-burning equipment is provided and kept in readiness for a quick changeover if necessary. Steam is maintained on the duplex oil pumps and oil heaters at

all times. Each boiler has four openings in the front wall for the burners. The cost of the oil-burning installation was small, as existing equipment was used.

The boilers are equipped with feed regulators, non-return valves, soot blowers and water-level recorders at the floor level (in addition to the usual water columns).

Over-all boiler-unit efficiencies (including economizer) range from 81 per cent to 84 per cent.



**The camera has played a trick with this manifold connecting boiler drum to water walls**

Make-up water, generally less than 50 per cent of the total feed, is drawn from Snow Mill pond, with city water as an auxiliary supply. While the pond water is reasonably clean and soft, treatment is necessary for operation of water-walled boilers at 400 lb. pressure and high ratings. After passing through conical sand filters the water is treated with carbonate of soda, anhydrous sodium sulphate, trisodium phosphate, and quebracho extract prescribed by Hall System.

Water pumped from the surge tank is heated to 214 deg. in a deaerating open heater supplied with steam through a reducing valve from the 35-lb. exhaust line. It is then forced directly to the economizers by a motor-driven centrifugal pump (with a turbine-driven spare).

Byproduct power is generated by three turbine-generators with capacities of 3,000 kw., 1,500 kw. and 1,000 kw. Further details regarding these units are given in the table of equipment.

The method of operation is of particular interest. With partial interconnection with the utility power lines, the economic effect of complete interconnection is obtained while retaining the advantages of a single power supply for the paper machines. To avoid injurious speed changes, that might be caused by line disturbances, all paper machines in Mills No. 6 and No. 7 (Mill No. 9 has no paper machines) are supplied through an independent line from the 1,000-kw. turbine or the 1,500-kw. turbine. The choice of turbine depends on the expected load. One of the other turbines pumps into the New England power lines through an outdoor transformer station. The output of the second turbine is adjusted automatically by back-pressure throttle regulation to supply all process steam needed in excess of the exhaust of the turbine employed to carry the paper-machine load.

All motor and lighting load in the mills outside of the paper machines is supplied directly from the lines of the power company. In this way the plant operates at all times with an exact balance between power generated and process steam. The 3,000-kw. turbine was installed to take care of winter loads when combined steam demands for process and building heating are heavy.

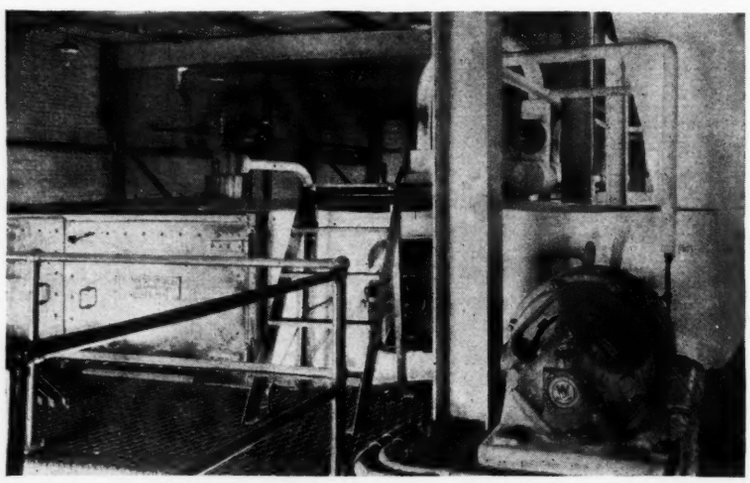
The amount of electricity put into the New England Power Company feeders at the central plant is deducted from that recorded by the power company's meters at the mills, after adjustment for a proper share of the losses in distribution and transformation to mill voltage. A fixed yearly sum is paid to the power company for the use of these facilities.

The agreement stipulates that at no time shall power be fed back into the New England Power Company's main system. That is the feed-in from the central plant may not exceed the amount drawn out at the mills. Since Crocker, Burbank's total demand on the power company is 6,000 kw. or more and the central plant at its peak steam load could put out only some 2,000 kw. in excess of paper-machine requirements, there is no danger of this.

As may be seen from the table of equipment, the station is well equipped with instruments and meters.

The fine general appearance of the station has already been mentioned, but it is a feature worthy of additional emphasis. It is not unusual today to find industrial plants where everything is neat and shipshape. Few industrial power plants, however, can boast a turbine room 36 ft. high, flooded with light through 1,600 sq.ft. of window area.

All in all, the Crocker, Burbank central steam plant is a new high-water mark in industrial power plants, designed for complete utilization of fuel, for reliability and for the utmost ease of operation.



**Economizers laid horizontally to conserve height and space in the boiler room**

The writer wishes to acknowledge his indebtedness to Messrs. Alvah Crocker and Douglas Crocker of Crocker, Burbank & Company for release of the information here contained, and to Francis J. Sill, the consulting engineer and his associates, W. H. Boland and F. E. Bailey, for much assistance in collecting the data.

# Principal Equipment in Crocker, Burbank Central Power Plant

Location ..... Fitchburg, Mass.
Put into operation ..... May, 1929
Owned by ..... Crocker, Burbank & Co. Ass'n.
Application .... Supplies power and process steam to group of paper mills
Consulting engineers ..... Francis J. Sill, Westboro, Mass.
Contractors:
Building ..... Wiley & Foss
Piping inside ..... Jennison Co.
Piping, outside lines ..... Parks Cramer Co.
Pipe covering ..... Keasby & Mattison
Furnaces ..... Frank E. Ross Co.
Air-duct insulation ..... Johns-Manville Corp.
Architect for building ..... John DeWolf, Boston

### Boilers and Furnaces

Number of boilers ..... Three
Manufacturer ..... Babcock & Wilcox Co.
Type, horizontal water tube, cross drum
Furnace, water-cooled on 2 sides and by superheater on back; air-cooled on bottom
Slag screen ..... None
Manufacturer of water walls ..... Foster Wheeler Corp.
Superheater, radiant type ..... Foster Wheeler Corp.
Steam pressure, lb. gage ..... 400
Steam temperature, deg. F ..... 645
Heating surface, sq.ft.:
Boiler proper ..... 4,893
Water walls ..... 368
Superheater (radiant) ..... 114
Furnace volume, cu.ft ..... 3,450
Normal volume capacity, lb. per hr. ..... 44,000
Maximum steaming capacity, lb. per hr. ..... 60,000

### Economizers

Number, per boiler ..... One
Manufacturer ..... Foster Wheeler Corp.
Heating surface, sq.ft ..... 2,500
Type, high-pressure, extended-surface, counter-flow, laid horizontally
Induced-draft fans, number per boiler ..... One
Make ..... (Sirocco) American Blower Co.
Capacity, 36,000 cu.ft. per min. at 6.25-in. static pressure
Drive, Westinghouse 2,200-volt, 75-hp. slip-ring motor
Control, located on firing floor at boiler fronts

### Pulverized-Fuel Equipment

System, Unit (Aero) 1 pulverizer per boiler
Manufacturer ..... Foster Wheeler Corp.
Capacity (each), tons per hour ..... Three
Drive, 75-hp., 2,200-volt G.E. induction motor
Power consumption, 17 kw.-hr. per ton, including air
Fuel used ..... Pocohontas coal
Fuel quality, 14,200 B.t.u., 4 per cent moisture, 5½ per cent ash.
Fineness of grinding, 80 per cent through 100 mesh
Burners, 2 per boiler, firing obliquely near top of furnace
Primary air, 20 per cent, drawn from beneath furnace floor at approximately 400 deg.
Secondary air, 80 per cent, admitted through dampers in furnace front

### Auxiliary Oil-Burning Equipment

Burners, 4 per boiler .. Hammel Oil Burning Equipment Co.
Duplex oil pumps, 2 .. Worthington Pump & Machinery Corp.
Oil heaters, 2 ..... Elliott Co.
Duplex oil strainer ..... Elliott Co.

### Coal-Handling Equipment

Storage, beneath railroad siding trestle
Drag scraper ..... Sauerman Bros., Inc.
Belt to magnetic separator ... Stephens-Adamson Mfg. Co.
Magnetic separator ..... Dings Magnetic Separator Co.
Distributing belt and tripper .. Stephens-Adamson Mfg. Co.
Coal bunker, 250-ton, unlined steel, suspended Eastern Bridge & Structural Co.
Automatic coal scales ..... 1 per pulverizer
Manufacturer ..... Richardson Scale Co.

### Ash-Handling Equipment

Steam jet vacuum removal system, maker, Girtanner Eng. Corp.
Concrete bunker, discharging to trucks, maker, Wiley & Foss

### Boiler Equipment
(other than meters)

Feed regulators ..... Stets Co.
Non-return valves ..... Edward Valve & Mfg. Co.
Safety valves, 2 on drum, 1 on superheated line, Consolidated Ashcroft Hancock Co.
Blow-off valves ..... Yarnall-Waring Co.
Soot blowers ..... Diamond Power Specialty Corp.
Water columns ..... Reliance Gauge Column Co.
Water-level recording gages ..... Foxboro Co.

### Breeching and Stack

Breeching, located on roof ..... Connery & Co.
Stack, brick ..... Alphons Custodis Chimney Constr. Co.
Dimensions: Height, 200 ft.; internal diam. at top, 10 ft.

### Reducing Valves and Desuperheaters

Desuperheater, 1 ..... Elliott Co.
Application: Desuperheats steam reduced from 400 lb. main to 35 lb. main, manual control
Reducing valve, 400 lb. to 35 lb., Ruggles-Klingemann valve and control
Reducing valve, 400 lb. to 150 lb., Ruggles-Klingemann valve and control
Application: Serves 150-lb. auxiliary line to oil pumps, oil heaters and steam-jet ash ejector.

### Water Supply and Treatment

Make up, per cent: Less than 40 per cent normally
Source: Snow Mill pond, gravity supply (also city water, if necessary)
Quality: Fairly soft and clean
Sand filter, 2, conical, 2 ..... Cochrane Corp.
Feed treatment: Hall system of boiler-water conditioning
Chemicals fed to boiler: Carbonate of soda, anhydrous sodium sulphate, trisodium phosphate, quebracho extract

### Feed Heaters

Deaërating open heater, 1 ..... Cochrane Corp.

### Boiler-Feed Pumps, Etc.

Number, type, capacity, 2, centrifugal, 200 gal. per min. at 1,130-ft. head
Make ..... (Cameron) Ingersoll-Rand Co.
Drive: One 125-hp. Terry turbine operating at boiler pressure; one 125-hp., 2,200-volt Westinghouse motor
Differential pressure regulator on motor-driven pump ..... Swartwout Co.
Surge tank pumps: Two, 200 gal.-per-min. Cameron centrifugal, motor-driven

### Turbine Generators and Auxiliaries

Number ..... Three
Make ..... Westinghouse
Throttle conditions, 385 lb. gage and 645 deg. F
Exhaust pressure, lb. gage ..... 35
Current, 3-phase, 60-cycle, 2,300 volt
Type, straight back pressure, combined impulse and reaction
Speed, r.p.m. ..... 3,600
Capacity, one 3,000 kw., one 1,500 kw., one 1,000 kw.
Guaranteed steam rates, lb. per kw.-hr.:

| | 3,000-Kw. Unit | 1,500-Kw. Unit | 1,000-Kw. Unit |
|---|---|---|---|
| One-half load | 28.7 | 34.0 | 36.4 |
| Three-quarter load | 26.1 | 29.2 | 31.47 |
| Full load | 25.6 | 27.5 | 29.0 |
| One and one-quarter load | 26.0 | 26.5 | 28.4 |

Air washing, closed system ..... Spraco, Inc.
Normal operation of turbines: 1,000-kw. or 1,500-kw. unit carrying straight paper machine load. One other unit loaded to meet additional steam demand and delivering all power to lines of N.E. Power Co. for distribution to mills.
Exciters (three motor-generator sets) ..... Westinghouse (Storage battery for emergency)
Motor-generator set, 5-kw., Westinghouse, furnishing direct current for storage battery, pulverizer feed, and magnetic separator.
Outdoor transformer station: Ties 2,300-volt bus to 13,000-volt lines of New England Power Co. Equipped with 15,000-volt solenoid-operated oil circuit breakers.
Manufacturer ..... Westinghouse Elec. & Mfg. Co.
Switchboard, 16 panel, slate, remote control, electrically operated ..... Westinghouse

### Other Valves

Manufacturers ..... Consolidated, Ashcroft, Hancock Co., Chapman Valve Mfg. Co., Henry Vogt Machine Co., Walworth Co.

### Meters

Boiler meters, 3 ..... Bailey Meter Co.
Temperature recorders, 2 ..... Foxboro Co.
Pressure recorders, 1 ..... Foxboro Co.
$CO_2$ recorders, 2 ..... Foxboro Co.
Venturi feed meter ..... Simplex Valve & Meter Co.
Multi-pointer draft gages, 3 ..... Bailey Meter Co.
Fluid meters (steam-flow, temp., pressure to turbines), 3 ..... Bailey Meter Co.
Boiler meters, 3 ..... Bailey Meter Co.
Turbine back-pressure recorder, 1 ..... Foxboro Co.
Turbine exhaust-temp. recorder, 1 ..... Foxboro Co.
Turbine oil temp. recorders, 3 ..... Foxboro Co.

### Outdoor Steam Transmission Lines

Contractor ..... Parks Cramer Co.
Pressure at station, lb. gage ..... 35
Length north from station, ft. ..... 1,300 (approx.)
Length south from station, ft. ..... 1,000 (approx.)
Diameter, in. ..... 14 in. North, 12 in. South
Joints, all lap welded
Expansion provision, 8 D.O. bends at 250 ft. to 400 ft. intervals
Support, concrete and steel piers
Insulation, 3-in. thick, 85 per cent magnesia, layer rosin-sized paper, layer roofing paper
Pressure drop:

| Pressure Drop Drop, Lb. | Steam Flow Lb. per Hr. |
|---|---|
| North 2 | 20,000 |
| South 2 | 25,000 |

### Miscellaneous Equipment

Turbine oil filters ..... S. F. Bowser & Co.
Traveling crane in turbine room, 15 ton .... Whiting Corp.
Switchboard and equipment. Westinghouse Elec. & Mfg. Co.
Purifiers, Hagan, with Nicholson traps between boiler drums and superheaters
Storage battery, 60 cell ..... Exide

# High Speeds *Made Possible* for Single-Cylinder Gas Engines

***In spite of the fact that the single-cylinder two-stroke cycle gas engine is inherently unbalanced, the company with which I am connected has been able to raise the speed of a 13¼x16-in. engine to 500 r.p.m. without setting up bearing pounding or vibration.***

***This has been accomplished by the use of high-pressure lubrication of the crankshaft, crankpin and crosshead-pin bearings, along with lightening the reciprocating parts.—G. L. R.***

**By GEORGE L. REID**
*Joseph Reid Gas Engine Co.*

HERETOFORE engine designers have felt that a speed of 250 r.p.m. was the approximate high limit for single-cylinder gas engines. However, present-day demands for higher swabbing and drilling speeds in oil-well work created a necessity for a higher-speed engine. This led to a study of the best means of attaining high speeds without bearing pounding or vibration.

The principal specifications of the engine investigated are given in the accompanying table. As originally designed, the engine was lubricated by a splash system to the main bearings, the crankpin, the crosshead pin and to the crosshead guides. The cylinder was lubricated at the top and sides by a Manzel force-feed oiler. The governor was lubricated by a small flood pump in the camshaft-bearing box, and the other accessories were oiled by splash from the governor.

Initial experiments centered around the piston. The original piston was of cast iron of the shape shown in Fig. 2. It weighed 325 lb. complete with the piston rod. With this piston a knock developed at a speed around 250 r.p.m.

In an effort to eliminate the pound, an aluminum piston was cast, the shape of which followed that of the original cast-iror piston. The aluminum piston alone weighed 107 lb., and 145 lb. complete with its rod and rings.

With this piston installed the engine was carefully broken in and the load applied. A a speed of 292 r.p.m. and with a 68 b.-hp. load no knock was detected. However, the piston failed at this speed, a hole blowing through its head just above the rod. Examination disclosed that the hole had been caused by heat in the cylinder. Nevertheless, it was demonstrated by this test that lightening the reciprocating parts tended to quiet the knock as the speed increased.

The next piston used was of cast iron and of the original design, but lightened in the barrel. Its weight was 300 lb. complete, 25 lb. less than the original. Lighter counterweights were used and the connecting rod weighed 166.4 lb. The crosshead with its pin weighed 148 lb.

The engine ran up to 280 r.p.m. with no knock, but at

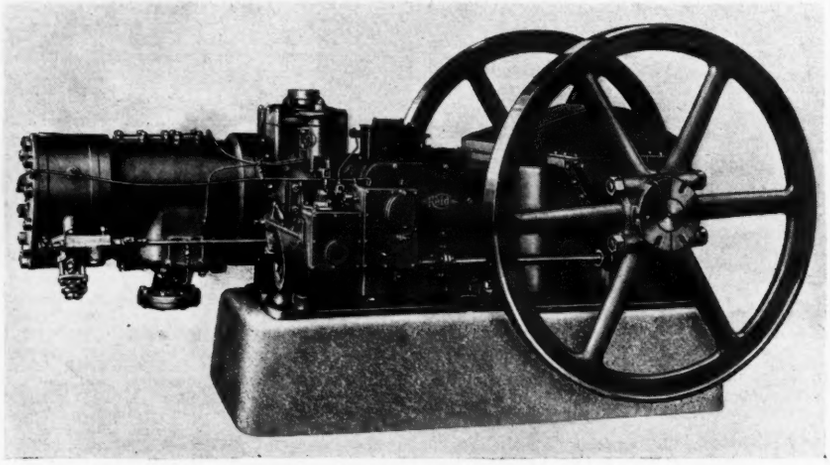


**Fig. 1—Single-cylinder two-stroke-cyclegas engine operating at 500 r.p.m.**

this speed a bad pound developed at the bearings.

A new connecting rod weighing 137 lb., 29.5 lb. less than the former was then installed. Under these conditions, with a 300-lb. piston and a connecting rod weighing 137 lb. (a reduction of 54½ lb.), the engine ran quietly up to 310 r.p.m. At this speed a slight knock was detected, but the engine ran up to 360 r.p.m., at which speed it delivered 72 b.-hp., before it developed a knock at all comparable to the one that appeared in the original engine at 250 revolutions per minute.

Retaining the light rod and the crosshead, a still lighter piston with a thinner section through the head was installed. This piston weighed 243 lb., 57 lb. less than the preceding one, and good performance was shown up to 310 r.p.m. But backfiring began at this point, and satisfactory running could not be continued. Pre-ignition due to the heating of the reduced section of the head of the piston caused further tests of this piston to be abandoned.

Being satisfied that reduction in weight of the reciprocating parts would lessen the shock, experiments were conducted to reveal any contributory factors that might be present. Experiments were made to see what results might be attained by changes of compression pressures,

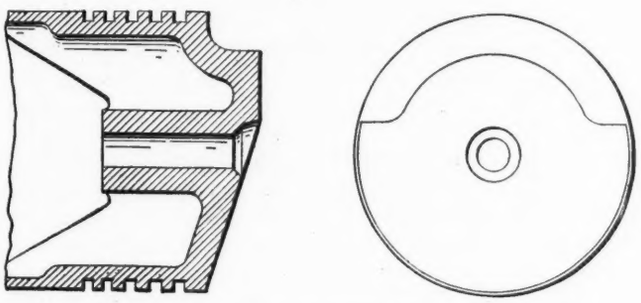


**Fig. 2—Original design of piston used on the engine**

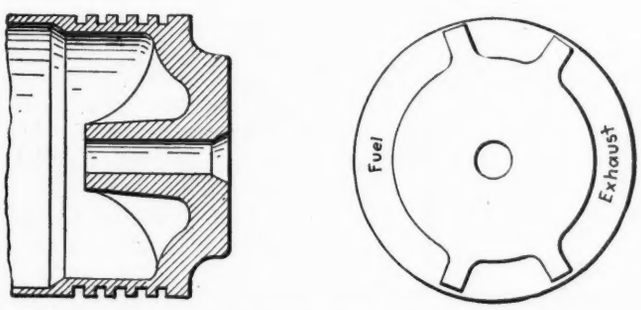



**Fig. 3—Piston design that was used later**

stiffening the crank, reducing the volume of the ingoing charge, changing the shape of the piston, and introducing the spark at a point other than at the axis of the cylinder head.

Compression was varied by different combustion heads of somewhat deeper clearance space than that of a standard head. Raising the compression was accomplished by use of a head of somewhat shallower clearance. General contour of the original head, however, was maintained in each case.

The low-compression head subjected the engine to frequent backfire. Various types of pistons were installed, but no satisfactory runs were made.

A high-compression head allowed the engine to run up to a speed of 330 r.p.m. without a knock. This was an increase of 20 r.p.m. before initial detection of the knock. The parts used included the 137-lb. connecting rod and the 300-lb. piston already mentioned. The compression was raised from 90 to 100 lb., but that was undesirable, due to the fact that bad sulphur conditions are encountered in some parts of the oil fields and there would be a consequent detrimental effect upon cylinders and pistons.

The crank was made stiffer by thickening the web

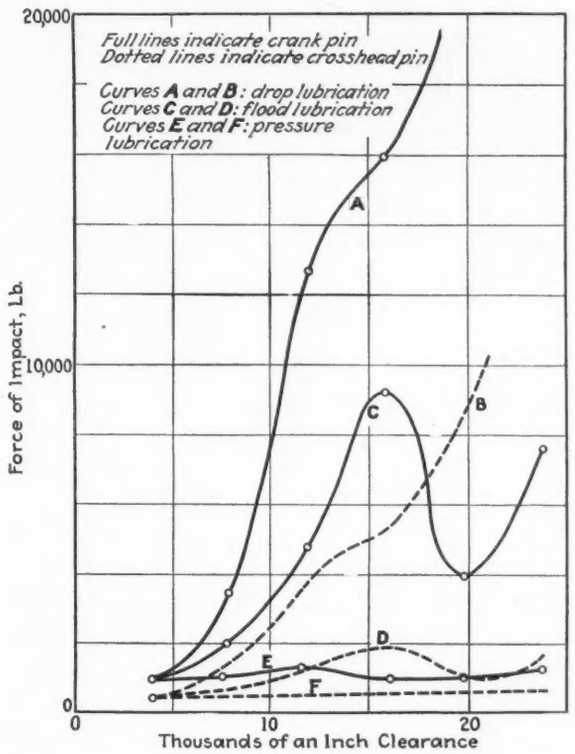



**Fig. 4—Relation of bearing impact with different types of oiling**

section, but all experiments showed no benefit from this, so that the original crank was retained.

Choking the air intake reduced the pound. This was accomplished, of course, by decreasing the maximum explosion pressure. Due, however, to the lowered compression pressure resulting from the reduced charging volume, the net force at the end of the stroke tended to increase on the crankpin bearing. This was undesirable and later found to be unnecessary.

It was thought that introduction of the spark at some point other than the axis of the cylinder and combustion head might improve the condition. Accordingly, a combustion head was cast which allowed introduction of the spark in the upper region of the combustion chamber. Up to a speed of 200 r.p.m. there was prohibitive backfiring. The temperature of the discharge cooling water increased 20 deg. above that obtained in previous tests with an equal flow. A considerably greater volume was required to maintain equal temperature.

At this time a new piston head, as illustrated in Fig. 3, was installed. It weighed 255 lb. complete and was of cast iron. The crosshead and its pin were lightened 38 lb., and the connecting rod weighed 137 lb., while the counterbalances were reduced to 350 lb. This meant a total reduction of 73 lb. in the reciprocating weights below the weights used in the previous piston experi-

SPECIFICATIONS OF ENGINE INVESTIGATED

| | |
|---|---|
| Bore, in. | 13¾ |
| Stroke, in. | 16 |
| Rated horsepower at 180 r.p.m. | 45 |
| Developed horsepower at 180 r.p.m. | 58 |
| Developed horsepower at 400 r.p.m. | 90 |
| Compression, lb. per sq.in. | 90 |
| Ratio of connecting rod to crank | 5 |
| Crosshead of pin dimensions, in. | 4.5x5 |
| Crankpin, in. | 6x5.5 |
| Main bearings, in. | 5.75x7.5 |
| Number of piston rings | 6 |
| Width of rings, in. | ⅜ |
| Weight of reciprocating parts, beginning of test, lb. | 593 |
| Weight of reciprocating parts, end of test, lb. | 410¼ |
| Weight of rotating parts, beginning of test, lb. | 350 |
| Weight of rotating parts, end of test, lb. | 300.5 |
| Heat content of natural gas used B.t.u. | 1,200 |
| Altitude of tests, ft. | 1,000 |
| Average barometric pressure, in hg. | 29.1 |
| Average fuel temperature, deg. F. | 70 |
| Ignition by Wico magneto | |

ments, or a total reduction of 433 lb. since the original design of the engine.

The engine now showed excellent performance up to 370 r.p.m. and no pronounced knock was detected up to a speed of 410.

However, to be satisfied that all possible had been done, L. H. Morrison, of New York, was called in to make a study of the engine. He came to the factory and saw the engine under actual running conditions.

His report bore out, from a technical standpoint, the results of the experiments. It was decided to follow one more of his recommendations. This was the installation of a pressure-oiling system for the crankpin and the crosshead pin. It was argued that the pound was the result of the pressure changing from one side of the bearing to the other. The knock was caused by the hammer blow delivered when the two parts, the bearing and pin, came into contact. If there were no clearance there would be no pound, and if oil were introduced into the clearance at the proper pressure the mechanical clearance would disappear and pounding would be eliminated. Tests on a uniflow engine, recorded in Fig. 4, indicated that the argument was valid, for it will be observed that the impact blow with pressure feed is far under that with gravity feed.

A pump was constructed to furnish oil at 50-lb. pressure to the main bearings, the crankpin and the crosshead pin. With this oiling system, speeds in excess of 500

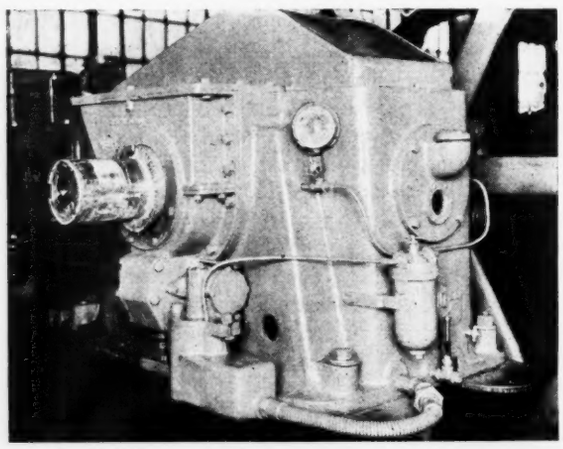


**Fig. 5—Arrangement of the forced-feed pump and piping**

r.p.m., or 1,350-ft. per minute piston travel, have been attained without any knock of consequence being noted.

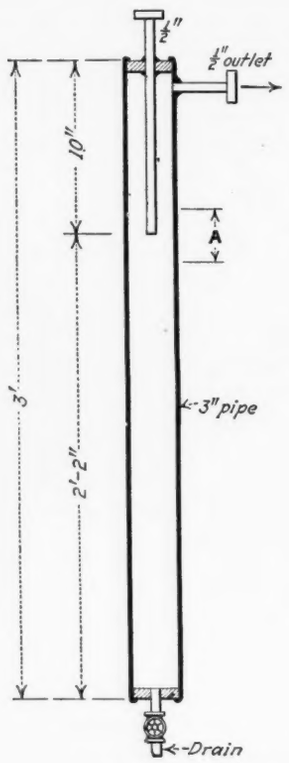
The crankshaft is drilled so that oil flow from the main bearing to the crankpin and the connecting rod is drilled so that the oil passes through the rod head to a copper tube which carries the oil along the outside of the rod to the crosshead end, where it again enters the rod and flows to the crosshead pin.

It is definitely proved that pressure lubrication permits the operation of the engine at an overload on the properly balanced rotating and reciprocating parts which otherwise could not be handled without serious detriment to its life and operation.

# A Simple Ammonia Clarifier

By R. S. Wheaton

LUBRICATING oil is essential to the proper operation of an ammonia compressor, but when this lubricating oil leaves the compressor in discharge gases it should be recovered before it gets over into the cooling coils in the evaporative side of the system. Otherwise it will be deposited inside of the coils and cut down the plant efficiency by retarding heat absorption, as oil is an insulator. In an effort to take the oil out of the liquid ammonia in an ammonia high-pressure feed line, the equipment shown in the sketch was built and placed in operation.

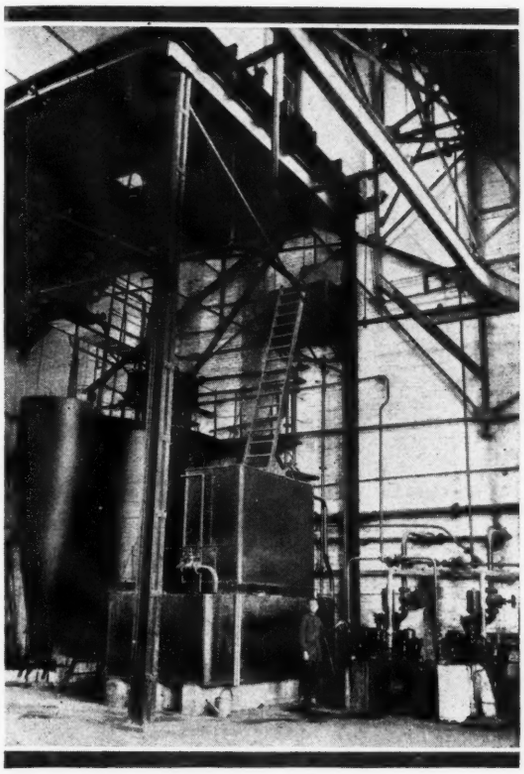



**The ammonia clarifier tested**

Excellent results were obtained, and a further study of the action occurring inside of the equipment was undertaken by inserting a piece of clear glass at the point marked *A*. A piece of white paper was placed behind the glass pipe and bright daylight was used for lighting.

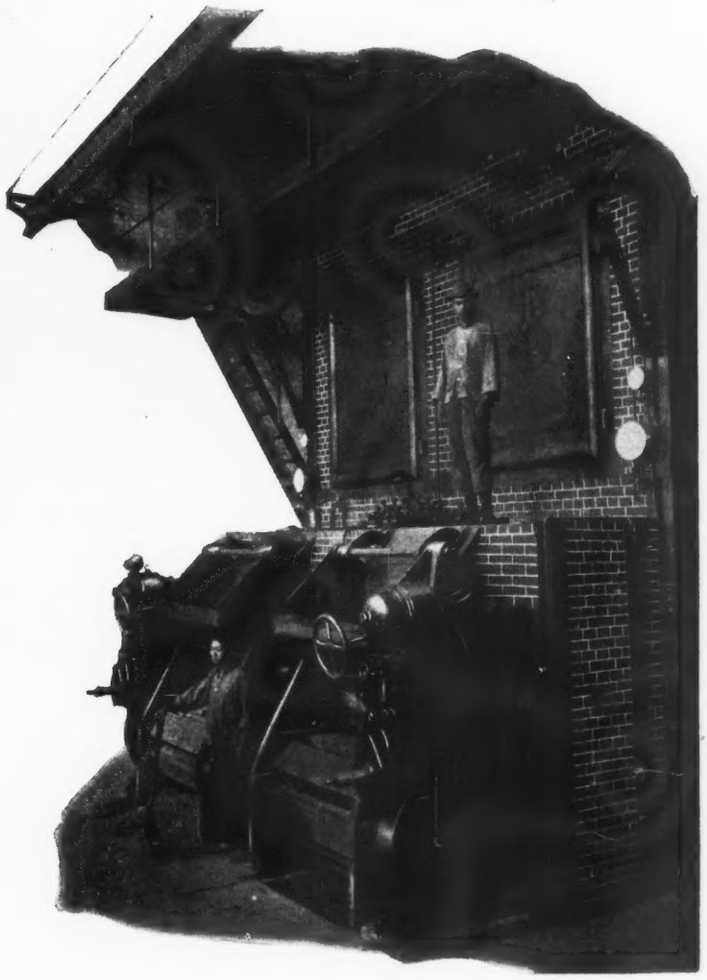
Oil that came over from the liquid receiver did so in the form of very fine particles, about the size of pin points, and shot straight downward toward the bottom of the clarifier, together with an occasional flake of dirt. The rate of flow, or velocity, downward in the small pipe compared to the upward flow in the large pipe was in the ratio of 28 to 1, and this, combined with the complete reversal of direction of flow and also the difference of specific gravity between the oil and ammonia, resulted in only a pure colorless ammonia leaving the clarifier.

Oil was then injected into the liquid line leading to the equipment, and the oil dripped off of the edge of the small pipe, just as though there was no ammonia present. There was no combining action noticeable under pressures of 100 to 150 lb. in the high-pressure side.



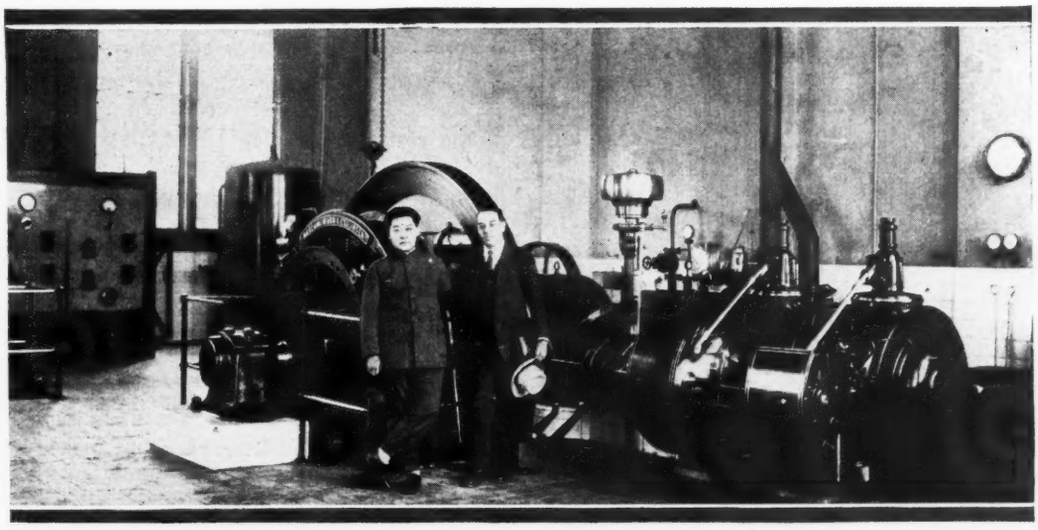
Left — The water-softening plant

Below — German boiler and stoker



# *Power Progress in Asia*

EVEN in sleepy old Asia are to be found, here and there, little centers of modern thought and modern industrial methods. These pictures, showing power equipment at North Eastern University, Mukden, Manchuria, were brought back by Fred H. Colvin, editor of *American Machinist*, who attended the recent World Engineering Congress in Tokio.



Stumpf uniflow engine. Dr. Yong, director of North Eastern University, at left

# *How to Check the* POLARITY of FIELD COILS

**Before direct-current machines will operate properly their field coils must have correct polarity, which must be established under a number of conditions. This can easily be done by the simple practical tests here described.**

By M. A. WALKER
*Cleveland, Ohio*

DIRECT-CURRENT machine field coils are so simple that the wide variety of troubles they may cause are frequently overlooked. If care is taken to have these coils connected to give the polepieces correct polarity, it is generally considered that trouble from this source will be rare. To a degree that is true, but many faults that develop in motors and generators have their origin in the field coils. Machines, however, are not always put into service with their field-pole polarity correct.

There can be little excuse for putting a machine into operation with some of the field coils having wrong polarity. Before the field coils are put in they should first be tested for polarity. This can be done easily by connecting them in series as in Fig. 1 and testing with a compass. When their polarity is correct, the compass needle will point in opposite directions in adjacent coils, as indicated. Care must be taken when testing with a compass to hold it so that the needle is free to move. If this is not done the needle's polarity is likely to be reversed by the field coils and may result in some coils being wrongly connected.

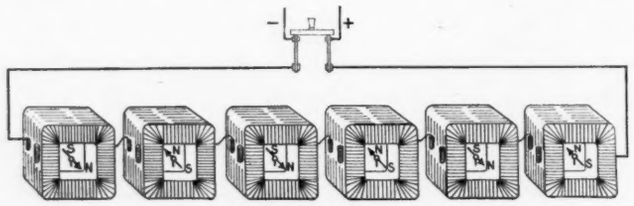


**Fig. 1—Method of testing a group of shunt field coils**

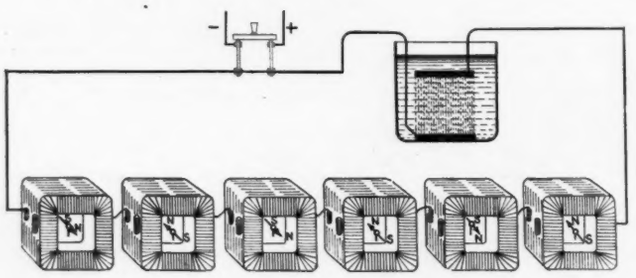


**Fig. 2—Method of testing a group of series- or commutating-field coils**

Shunt coils can be connected directly across the line, as in Fig. 1, for testing. If series or commutating-pole coils are taped up, as is the case in small machines, the direction of their turns cannot be traced; so they should be tested. These coils have a low resistance and must be connected to the line through a resistance. A water rheostat is convenient for this purpose (Fig. 2). A pail of water with a handful of salt in it will do. One electrode is placed in the bottom of the pail and the other is supported in the water near the surface. When the connections have been made, coils can be tested and arranged to obtain correct polarity in the manner explained for the shunt coils.

After coils are arranged so that their polarity is correct, they should be marked, all on the same side. For example, in the figure place a mark on the side of the coils facing the reader. When the coils are assembled on the polepieces all marked sides should face the same direction, such as toward the pole faces. After the coils are in place and connected, they should again be energized and the polepieces tested for polarity. The test can be made with a compass, but two nails may be used, as in Fig. 3. The points of the nails are placed on adjacent polepieces and their heads gradually brought together. If the nails are handled so they are free to

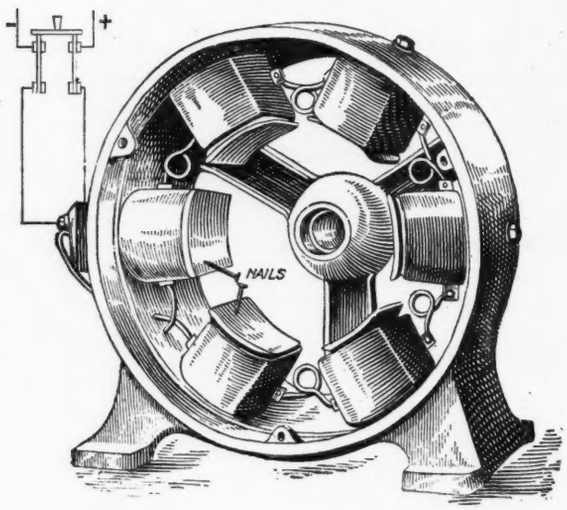



**Fig. 3—Testing the polarity of polepieces with two nails**

move there will be a decided attraction or a repulsion between them. Correct polarity is indicated by attraction between each pair of adjacent polepieces. If the original testing of the coils was right and the coils are put onto the polepieces correctly, the polarity of the field poles will be correct when tested.

It is not only necessary that the polarity of the field coils be alternate *N* and *S*, but also, in compound machines the shunt and series coils on the same polepiece must have the same polarity. Frequently machines are put into service when the relation between the shunt and series coils is wrong. The effect on a motor of the shunt and the series field coils having opposite polarity depends upon the relation between the ampere-turns in the two windings. It may only cause a slight increase in speed from no load to full load, but in most cases one or more of the following things take place:

1. The motor may start and operate satisfactorily under no load, but when load is applied its speed may suddenly increase, severe sparking develop at the brushes, and the protective device open.

2. The motor's speed may decrease and its current increase to where the fuses or circuit breaker will open; and if the motor is not properly protected it may reverse and run in the opposite direction and the brushes may spark badly.

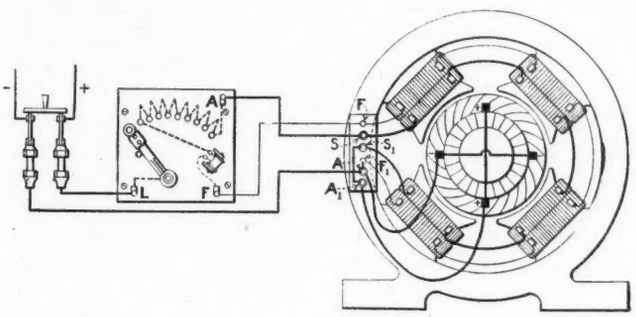


**Fig. 4—Diagram of a compound motor connected to a manual-type starting box**

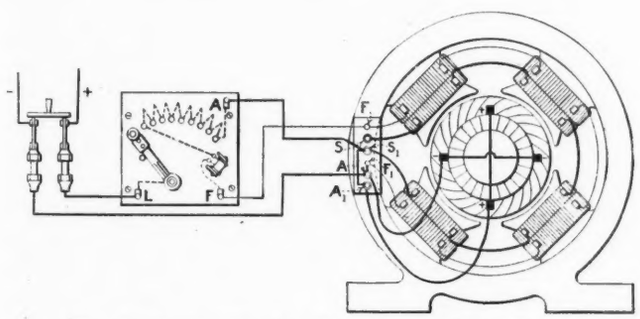


**Fig. 5—Testing rotation direction of motor, Fig. 5, on shunt field only**

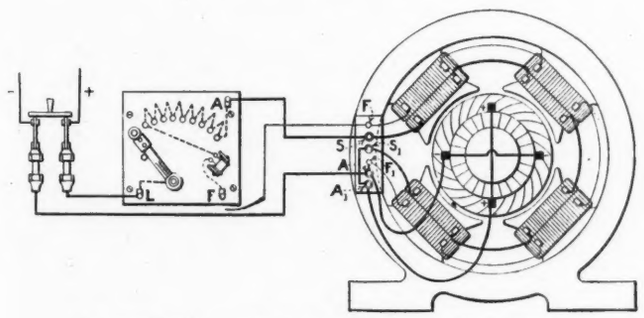


**Fig. 6—Testing rotation direction of motor, Fig. 5, on series field only**

3. The motor may start in one direction and run until the resistance is partly cut out, then reverse and run in the opposite direction.

4. The motor may fail to start; but the armature will usually make a slight effort to turn in one direction and then in the other.

If the series-field and shunt coils[1] turns have certain proportions, the motor's speed will be practically constant from no load to full load. Usually, however, this is true only in motors designed to operate that way.

There is no reasonable excuse for a compound motor being put into operation with the series and the shunt-field coils having wrong polarity, for a simple test will show the fault if it exists. After the motor has been connected and is ready for operation, as in Fig. 4, change the connection so as to cut out the series-field winding, as in Fig. 5, operate the motor as a shunt machine and note its direction. When it is operating satisfactorily in this way, put the connections back as they were originally and open the shunt field circuit, as in Fig. 6, and start the motor on the series winding. If the series

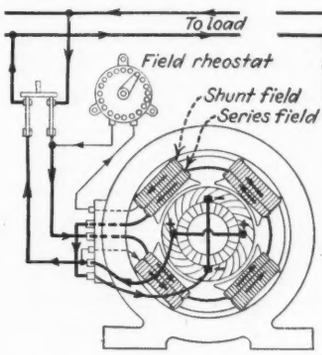



**Fig. 7—Diagram of a compound-wound generator**

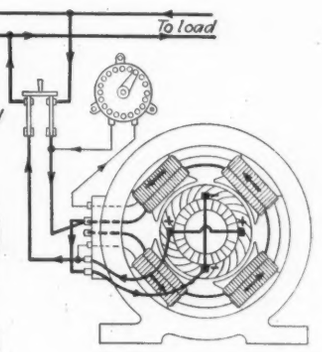



**Fig. 8—Same as Fig. 7, but with the series winding cut out**

coils have the same polarity as the shunt, the motor will start in the same direction on the series winding as it did on the shunt. When starting on the series winding do not cut the starting resistance out or the motor will race. Allow it to run only long enough to determine the direction of the armature's rotation.

When it has been determined that the series and the shunt field coils have the same polarity, the motor can be put into service as a compound machine. Care should be exercised not to make a mistake in the connections and get them different than they were when making the test.

Frequently one series and one shunt lead is connected inside the motor and brought to a single terminal. In such cases the correct polarity of the field coils is assumed to have been determined at the factory. However, it is always advisable to make a check on the field coils' polarity.

After the motor has been in operation as a compound machine, stop it, open the shunt winding and note if the direction of rotation is the same with the series winding as with both. These tests do not take very long, and if properly conducted they make certain that the connections are correct.

If the shunt and the series field coils of a generator have opposite polarity, the voltage will drop rapidly when load is put on the machine. Nevertheless, generators have been put into operation and allowed to

operate that way for long periods without the fault being corrected. After a machine has been put into service and its voltage drops as the load increases, a test can be made by cutting out the series winding and operating the unit as a shunt generator. If the original connections were as indicated in Fig. 7, then Fig. 8 shows the series field cut out of circuit.

If the series-field coils are opposing the shunt, the machine's voltage will decrease less for a given increase in load when operating as a shunt than when compounded. There is an exception to this rule in three-wire generators. They have the series winding divided, with the armature connected in between the two halves. It has happened that one half of the series winding was connected correctly and the other was not. Under these conditions this winding has no effect on the voltage, since one half neutralizes the effect of the other. The voltage of such a machine would be the same with the series winding in circuit as with it out. Three-wire generators should be tested with one-half of the series winding out of circuit at a time.

If the series winding opposes the shunt, the polarity of the series winding must be reversed. When the leads

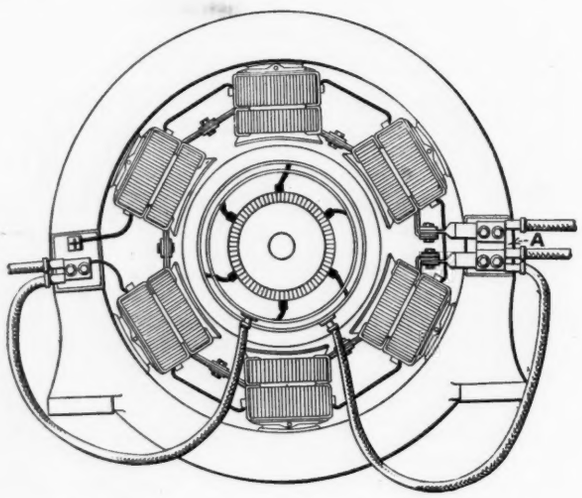



**Fig. 9—Compound generator with series leads made of copper bars**

from a series winding are flexible its polarity can be corrected by crossing the leads. On some machines the series leads are made of copper bars, as in Fig. 9, and cannot be crossed. Then the field coils' polarity can be corrected by shifting the brushes one pole space on the commutator and crossing the shunt-field connections.

A large compound generator was put into service that had three adjacent series-field coils the same polarity. This condition caused sparking at the brushes that could not be corrected by any of the usual cures. It was then decided to check the polarity of the series-field coils. This led to the cause of the trouble. The machine operated in parallel with another unit. To make the test its series-field coils were connected in parallel with the other unit, as in Fig. 10. On No. 2 machine the lead from the armature to the switchboard is disconnected at *A*. When this is done and the switch is closed, the series-field coils of No. 2 are in parallel with those of No. 1 unit. The load current of No. 1 unit divides between the series-field winding of the two units in inverse proportion to the resistance of the two paths. The direction of the current is indicated by arrowheads. With the series coils excited in this way their polarity can be checked with a compass.

On most compound generators, a shunt is connected in parallel with the series coil, as at *A*, Fig. 9, to

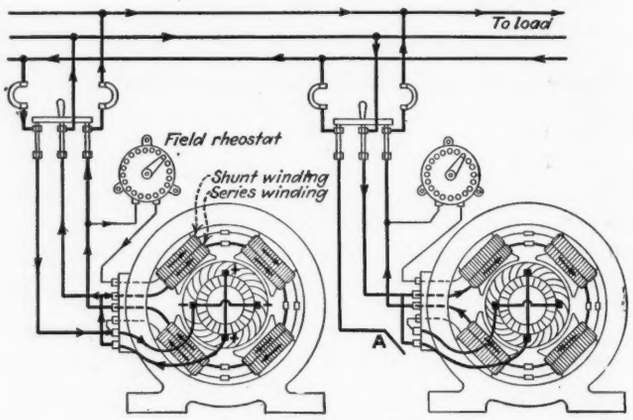



**Fig. 10—No. 2 generator's series coils excited by connecting them in parallel with those of No. 1 unit**

adjust the compounding to the desired value. Part of the load current goes through the shunt and part through the series winding. When the shunt is once adjusted to obtain proper division of current in the two paths, the adjustment may not remain constant. If one of the laminations in the shunt breaks; the connections to the series-field coils terminals becomes loose or corroded; or if the connections between the series coils develop high resistance, the division of the current will be changed. Poor connections between the series coils will increase the resistance and reduce the current through them and increase it through the shunt. If the resistance of the shunt circuit is increased the current will be increased in the series coils and decreased in the shunt. Where generators are operating satisfactorily in parallel and one machine develops a tendency to take the load from another, one of the first things to check is the series field and equalizer connections. If there is any doubt about any of these connections they should be opened, cleaned and again made up tightly.

The majority of modern direct-current machines are designed with commutating poles, as in Fig. 11. There is a definite relation between the polarity of the main poles, the armature poles and the commutating poles. These are shown in Figs. 12 and 13. In Fig. 12 the polarity is for a motor, and in Fig. 13 for a generator. In either case the commutating pole polarity is the same as that of the armature. On a motor the com-

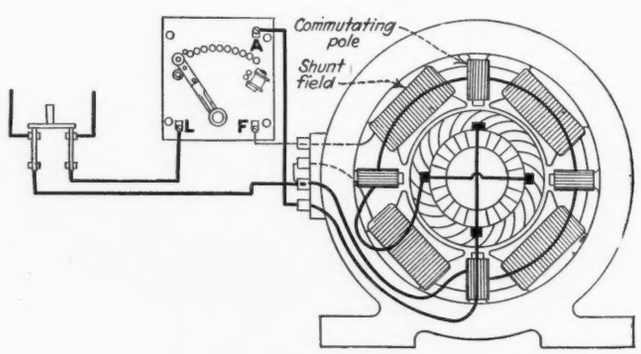



**Fig. 11—Commutating-pole shunt motor connected to manual-type starting box**

mutating poles have opposite polarity to the main pole ahead of them, in the direction of rotation. In a generator the commutating poles and their leading main poles have the same polarity. Direction of rotation is counter-clockwise in the motor in Fig. 12. The top commutating pole has *N* polarity and the main pole ahead of it in the direction of rotation has *S* polarity. The direction of rotation of the generator, Fig. 13, is clockwise, and the main pole ahead of the top commutating pole has *N* polarity, the same as the commutating pole. Commutating poles must be connected to give this polarity.

Frequently a shunt is connected across the terminals of the leads from the commutating-pole coils. This shunt is used to adjust the strength of the commutating poles to the correct value. Poor connections between the commutating-pole coils and between the shunt and the coil terminals, or a broken shunt, would change the current division in the coils and shunt. This may cause sparking at the brushes. Where such trouble develops in a com-

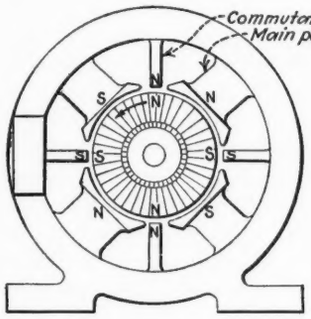



**Fig. 12—Correct polarity of commutating poles, armature and main poles in a motor**

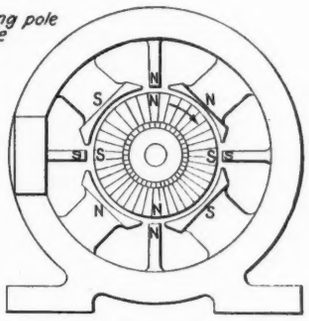


**Fig. 13—Correct polarity of commutating poles, armature and main poles in a generator**

mutating-pole machine, the connections between the coils and between the shunt and coil terminals should be opened, cleaned and made up tightly. Doing this may not cure the trouble, but until it is known that the commutating coils are in good condition there is little use looking for the fault elsewhere.

Other faults that may develop in the field coils are grounds, open circuits and short circuits in individual coils and short circuits between the series and short coils. The locating of these faults will be made the subject of a future article.

# Make Portable Lamps Safe For the Workman

By Robert Ball

Portable or extension lamp sets are often needed in the power plant. They must be dependable and well insulated to be of the utmost value to the workman. This means that the attachment plug, cord, socket and guard must be carefully selected and assembled. There is no economy in using makeshift or cheap materials for this service.

Rubber-armoured cable consisting of two No. 16 or 18 B. & S. stranded conductors makes durable and satisfactory cord for portable lamps. Rugged attachment plugs are necessary. After being connected to the cord, the attachment plug cap should be filled with melted insulating wax or compound to prevent short circuits at this point. Means should be provided to secure the attachment plug so that it cannot easily be pulled from the plug outlet. Sockets should be rugged, with exterior shells of insulating material, and not of the key type. Lamp sets sheathed in rubber from plug to socket have proved very satisfactory.

Every portable lamp should be protected by a guard that will enable a defective lamp to be easily and quickly replaced. Guards are necessary for two reasons: to protect the eyes, which are often brought near the lamp, and to prevent breakage of lamps. Aside from the important matter of safety, in one industrial plant it was found that the cost of an expensive guard would soon be saved by the reduction in broken lamps, and by less time lost while awaiting a new lamp.

Substantial metal guards should be used for general purposes. Guards made of insulating materials are available and should be used around switchboards. All lamp guards should be provided with a hook for support. In many locations guards should be equipped with reflectors.

Portable lamps not in use should be kept in central locations, such as store rooms or tool rooms, when practicable. Each should be carefully inspected periodically, and any defects remedied at once. Any found to be defective should be returned immediately to the store room. Since portable electric tools are a source of danger, they also should be regularly tested and inspected.

Lamp cords are usually 25 and 35 ft. long, but the proper length depends upon the locations of the plug outlets. There should be plenty of plug outlets, so that cords longer than 35 ft. will not be required. Plug outlets should not be connected to the lighting circuits, since it is often undesirable to operate other lamps when only a portable lamp is needed.

UNDER conditions where it is possible to make good contact with a grounded surface, as in tanks, boilers, penstocks and the like, and in damp locations, a dangerous shock may be sustained from a portable lamp connected to a 110-volt circuit. The danger can be reduced if portable cords and sockets are kept in good condition, but can be eliminated only by using low-voltage lamps.

One method of preventing shocks, applicable to alternating-current circuits only, is to insert a transformer in each portable-lamp cord intended for use in hazardous locations. Another method is to use low-voltage lamps entirely, and to provide low-voltage plug outlets throughout the plant. A third method is to operate portable lamps from portable transformers that are moved to locations where hazards exist. Sometimes lamps are operated from portable low-voltage storage batteries, but current from a central lighting system is preferable.

To prevent interchanging low-voltage lamps, usually rated at 24 or 32 volts, and the standard 120-volt lamps, the bases of the former should be provided with left-hand threads. Sockets and lamps having left hand threads can be obtained on special order at a slight advance in price. Where both types are used, cords for high-voltage and low-voltage service should be of dissimilar colors.

# POWER COST IN ICE PLANT

## Minimized by Equipment Selection

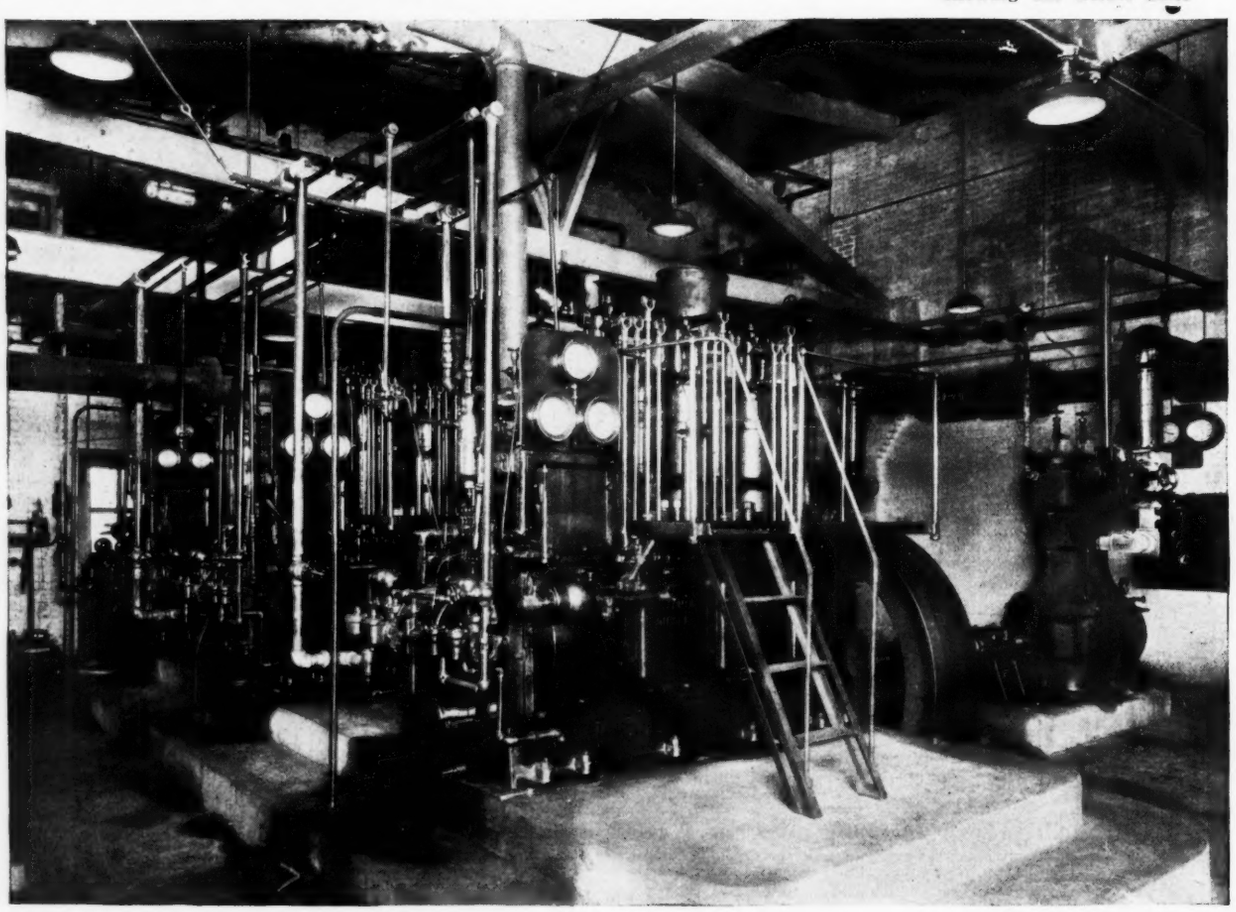
**Seldom do refrigerating engineers meet without finally discussing the cost of power, for the reason that the power needed to operate an ice plant is a major item in the total operating expense. However, the Arlington Ice & Fuel Company, Baltimore, Md., found that if the equipment in the power plant be chosen with judgment, power cost no longer is the important item; for fuel, lubricating oil and repairs are but 37.4 cents per ton output of ice.**

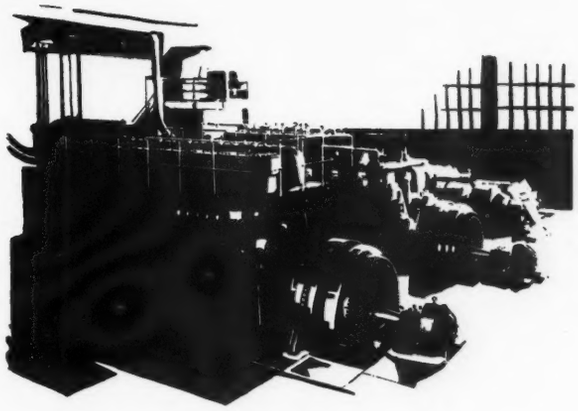
ORIGINALLY, this ice plant, now owned by the Arlington Ice and Fuel Company, was equipped with steam power, and operating costs were high. Eventually the plant was purchased by the present owners, who immediately began to study possible means of bringing ice-production costs within reason. This involved discarding the steam units and employing either purchased current or oil engines.

After due consideration, oil engines were decided upon, and three 110-hp. 9½x14-in. three-cylinder mechanical-injection Bessemer Diesels were installed. Two of the engines are direct connected to York vertical duplex 10x10-in. ammonia compressors of 40-ton rating at 300 r.p.m. The third engine is direct connected to a 75-kw. G.E. alternator and belt drives an exciter placed on a balcony above the engine. This generator drives the various auxiliaries, such as agitators and the several water pumps. To insure continuity of the service in event of trouble, a 50-kw. generator is located on the balcony so that it can be belted from the flywheel of one of the compressor units.

Ammonia condensers are cooled by water that originally is raised from a well by an air lift and empties into

**View of engine room, showing the Diesel units**





the cooling tower sump. A centrifugal pump then forces the water over the condenser, and a second centrifugal lifts it from the condenser sump and delivers it to the cooling tower. Both are on the roof and so placed that the water will not flow from the tower to the condenser by gravity head. At present two 40-ton shell-and-tube condensers are being installed inside the building, but pumping will still be necessary.

The well carries considerable scale-forming material, so city water is used for engine-jacket cooling. It flows through the jackets under city pressure into a steel sump tank, from which it is lifted by a centrifugal pump and put over the cooling tower.

Fuel oil is received in tank-car lots, and from this storage is lifted to the engine service tank on the balcony. Although the oil is high-grade 28 to 32 Baumé, it is centrifuged before use. The centrifuge's bowl is cleaned about once a week. This indicates that the actual quantity of impurities removed is small, nevertheless the exceptional continuity of service obtained from the engines is attributable to this precautionary filtration. In addition each engine is provided with a screen oil filter. In 1929 there were but two service interruptions, one on April 15 and the second on Sept. 13. In neither instance was the outage long enough to damage the ice in the freezing tanks.

Lubricating oil is stored in a tank on the engine room balcony, and the charges in the crankcase are centrifuged at regular intervals. For this reason the bearings are subject to so little wear that no adjustment is made during the ice-making season.

The oil pressure on the bearings is carried at 7 lb., indicating a somewhat liberal clearance prior to adjusting, but no bearing pound is evident.

In a further precaution against cylinder wear air-suction lines are provided with air filters. The exhaust lines are also equipped with silencers, which largely eliminates exhaust noise.

A feature not often observed on engines of such capacity are crankcase breather connections to the air-suction lines. These probably assist in eliminating oil fumes in the engine room.

As has been stated, fuel and lubricating costs per ton for 1929 were 32.7 cents. One engineer per shift of eight hours operates the plant, with the usual number of ice pullers and storage men. The total cost per ton chargeable to power generation, including overhead charges and engineers' wages, is approximately 87.4 cents. This is sufficiently below the estimated cost with purchased power, based on the expense in other local plants, to pay for the equipment in three years.

Last year the output was 19,000 tons, and the expected increase in business will make the plant inadequate. Consequently, a fourth 110-hp. Diesel and a 40-ton duplex single-acting compressor is being installed, along with two shell-and-tube condensers.

The compressors are not provided with clearance pockets, so to lower compressor capacity one unit must be shut down. If the capacity is still greater than needed, as in winter, engine speed can be reduced from 300 to as low as 150 r.p.m. Speed reduction does not alter the fuel consumption of the engine per horsepower output, and probably reduces to a slight extent the valve losses in the compressor. It is noticed, however, that at low load the exhaust temperatures are not as uniform as at full load. On one of the engines at full load the steam recorded was:

| Cylinder | Deg. F. |
|---|---|
| No. 1 | 700 |
| No. 2 | 710 |
| No. 3 | 725 |

When carrying a load estimated to be about three-quarters rating the pyrometer's readings were:

| Cylinder | Deg. F. |
|---|---|
| No. 1 | 600 |
| No. 2 | 600 |
| No. 3 | 650 |

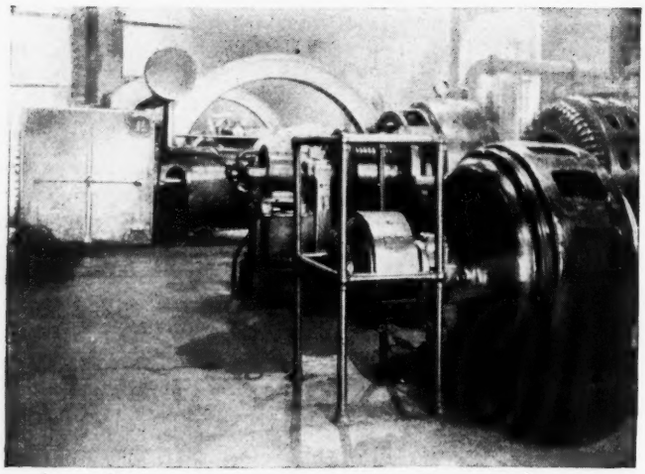
At half load the exhaust temperatures were:

| Cylinder | Deg. F. |
|---|---|
| No. 1 | 425 |
| No. 2 | 510 |
| No. 3 | 475 |

The lack of uniformity is due to governor action on the valve gear. This engine has three fuel plungers delivering into a common manifold, or "rail." The fuel valve is of the needle type, opened by a cam and closed by spring pressure. The governor acts upon a wedge inserted in the lower end of the fuel valve rocker arm, controlling the effective lift of the rocker arm and needle valve.

## Principal Equipment Arlington Ice and Fuel Company

Compressors, three 10x10-in. duplex single acting, 40-ton capacity ..... York Ice Machinery Corp.
Generators, one 75-kw., 300-r.p.m., direct connected to engine; one 40-kw., 900-r.p.m., belted to engine ..... General Electric Company
Engines, three 110-hp., 9½x14-in., three-cylinder Diesels; two direct connected to York compressors, and one direct connected to the generator ..... Cooper-Bessemer Corp.
One 110-hp., 9½x14-in., three-cylinder Diesel direct connected to York compressor, Atlas-Imperial Engine Co.
Engine couplings ..... Bartlett-Hayward Co.
Fuel-oil purifier ..... De Laval Separator Co.
Fuel-oil filters ..... Zenith Corp.
Lubricating oil filters ..... De Laval Separator Co.
Lubricating and fuel-oil pumps, two ⅜-in., Blackmer Rotary Pump Co.
Engine water pump, one 2-in. centrifugal direct connected to 3-hp., 1,800-r.p.m. G.E. Motor, Gould Pumps, Inc.
Ammonia condenser water pump, two 4-in. centrifugal direct connected to 7½-hp., 1,800-r.p.m. G.E. motors ..... Worthington Pump & Mach. Corp.
Air lift compressor, one 6x6-in. duplex vertical S.A. 425-lb. compressor belted to 7½-hp., 1,200-r.p.m. G.E. motor ..... Gardner Denver Co.
Make-up water pump, one 2-in. centrifugal direct connected to 3-hp. 1,800-r.p.m. G.E. motor, Worthington Pump & Mach. Corp.
Agitation-air compressor, one 12x8-in., 325-r.p.m. 30-lb. compressor belted to 40-hp., 900-r.p.m. Allis Chalmers motor ..... Ingersoll-Rand Co.
New condensers, two shell-and-tube, 40-ton capacity ..... York Ice Machinery Corp.



Engine room at Housatonic plant at Bridgeport Brass Co.

**Showing that it is not always necessary to completely recondition a power plant to decrease the cost of power services. Improved operation and maintenance have netted handsome returns at this plant**

# $41,000 Annual Savings *from* $10,000 Investment

BELIEVING the performance and operation of the two power houses serving the Bridgeport Brass Company could be improved upon, the management engaged H. W. Brooks, consulting engineer, to investigate and make recommendations for reconditioning the plant. With the whole-hearted co-operation of the works manager, W. R. Clark; assistant works manager, A. Brewer; and of G. H. Fray, superintendent of power, rehabilitation of the two power houses was commenced in April of 1928. Results of operations during 1929 now show a reduction of annual operating costs of $41,000. Even yet the full effect of the improvements in plant operation have not been finally realized and it is believed that savings will continue to increase in the future. As the total cost of the changes made at both plants has not exceeded $10,000 it is evident that an unusually worth-while investment has been made, especially when it is considered that these plants have seen continuous service for about twenty years.

At the Housatonic plant ingots of brass and bronze are cast and subsequently used in the manufacture of bars, rods, tubing and sheet. The power house supplies direct current, steam for various processes and for building heating, high- and low-pressure water and compressed air.

Direct current is generated by two geared turbine-generator sets, of 1,250-kw. and 300-kw. capacity, both operated condensing. The smaller unit is arranged for bleeding steam to an exhaust header. This unit also drives a 400-kva. synchronous condenser normally used for power-factor correction.

Alternating current for induction-type electric furnaces and other uses as demanded by good heat balance is purchased. A 500-kw. motor-generator set makes it possible to supply direct current from purchased power or alternating current from power generated by the direct-current sets, depending upon thermal and economic balance. Water at 1,200-lb. pressure for hydraulic presses is furnished by two 600-gal. pumps. These are driven by 500-hp. cross-compound condensing double-eccentric corliss engines. Exhaust steam from the bleeder turbine, boiler feed and low-pressure service pumps and fan drives is used for feed water and building heating. During the winter steam from the receiver of a 1,000-hp. cross-compound condensing rolling mill engine is also used for building heat.

Five water-tube longitudinal-drum boilers, each of 3,370-sq.ft. heating surface, supply steam at 155-lb. pressure and 120-deg. superheat. The boilers were originally installed for hand firing. In 1919, however, heavy-duty type E stokers were installed, and although this stoker requires less height than other types, nevertheless building limitations necessitated low boiler settings and limited combustion space, which made proper firing difficult.

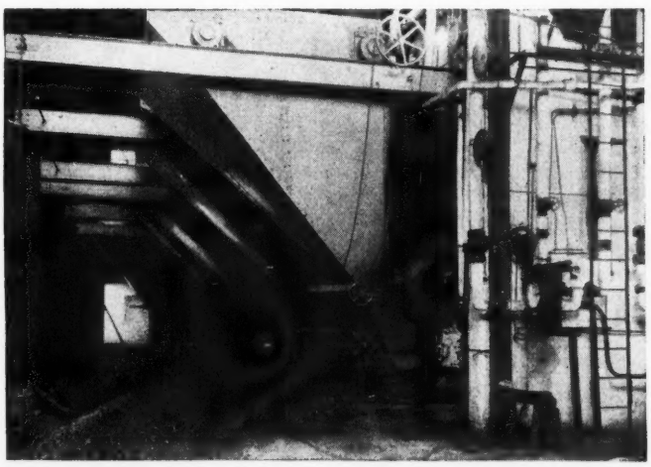
At the East Main Street plant eight hand-fired 72-in. x 18-ft. 1,500-sq.ft. boilers serve a 650-kw. non-condensing and a 400-kw., mixed-pressure, condensing, direct-current turbine-generator and two rolling mill non-condensing engines, as well as the requirements of process and heating steam, hot water and air. Although savings

already accomplished at this plant are proportionately as great as at the other, still further improvements, such as installation of stokers and coal-handling equipment, thermostatically controlled valves on process-steam-using equipment, etc., are proceeding or are in contemplation, which will still further fatten the savings record.

One of the difficulties encountered at both plants was an excess of fly ash and cinder, which deposited in the neighborhood and caused considerable complaint. It further jeopardized the rolling mill product by settling on the brass sheet and causing scratching and pitting. Elimination of this nuisance was one of the reasons for the decision to recondition the plant.

The first work in the boiler house at the Housatonic Avenue plant was to completely overhaul the stokers and in general to bring their deferred maintenance up to date. For this purpose the manufacturer was called in to supervise the work. All worn or burnt parts were replaced, and the pushers were set so as to give the best results with the coal used. Firemen were also instructed regarding best depth of fire and when and how to clean and keep the fire level.

After the stokers were overhauled, tests were made to determine the coal having the best burning characteristics for the side-dump stokers and the low-set boilers under which they are installed. The tests were run in the course of regular operation and five kinds of low-volatile New River nut and slack coal and two Pennsylvania high-volatile sized coals were tried.



**Bunkers are arranged so that they can be rolled back out of the way when turbining is necessary.**

During preliminary testing it was discovered that uniformity of coal size had a greater influence upon its performance in the stoker than did the amount of volatile, the percentage of ash, the particular field from which the coal came or even the heat content per pound. Finally, the less friable better-sized high-volatile Pennsylvania coals were resorted to.

In addition to evaporating a half pound more water per pound of coal than any of the other coals tried, its free burning characteristics made firing much easier. Where the other coals required 4 in. underfire pressure to produce a given rating, this coal required only 2 in. The result of this decrease in underfire pressure was elimination of the cinder nuisance. Also it had been necessary to remove 33,000 to 35,000 lb. of cinders each week from the last pass of the boilers. The new coal decreased this to about 5,500 lb. a week. As an analysis showed that the cinder had contained 60 per cent combustible, the saving in fuel through its elimination is obvious. The sized coal gives no trouble from clinker, the ash being very friable and low in combustible.

Last but not least, the price per ton was reduced by $1.50, while the over-all monthly boiler and furnace efficiency was being increased from about 66 to about 75 per cent without a single major change in the setting or equipment.

Combustion control equipment has been installed to regulate stoker, boiler uptake damper and the forced-draft fans. Savings due to automatic control are paying their costs from savings in about a year.

Automatic feed-water regulators replaced manual control—a particularly difficult operation on a rolling mill load without hunting of the boilers. The regulators paid for themselves in less than six months.

Until recently coal was delivered to the boiler house by a traveling crane and after being weighed was dumped on the boiler room floor. Firemen shoveled it from the floor into the stoker hoppers. The inefficiency of this is readily recognized, and hoppers have been installed for each stoker, into which the weighed coal is now dumped directly. Elimination of the shoveling operation made it possible to decrease the boiler room labor by 50 per cent. Instead of eleven men as previously required, a boiler room crew of five is now sufficient. As the men receive a weekly wage of about $30, the saving per month amounts to $770.

Lack of head room and general boiler house construction made it impossible to install coal hoppers above the boilers. They had to be installed in front where, unless special provision was made, it would be impossible to turbine or replace boiler tubes. Firing aisle being reasonably wide, this was overcome by installing the hoppers on wheels, so that they can easily be moved back out of the way when turbining. When retubing is necessary the wheels may be removed and the hopper lowered to the floor, giving the additional space needed for this work. Design and construction of the hoppers was carried out entirely by company personnel.

IN THE TURBINE ROOM a series of tests during operation and comparison with original guarantees revealed that water rates had increased unduly with the years of wear. Reblading and renozzling to fit present steam condition and bringing up to date the general deferred turbine maintenance reduced water rates nearly 20 per cent, as well as permitting heavier loads to be carried. Similar rehabilitation of the hydraulic pumps and their corliss drives contributed further worth-while savings.

A considerable amount of hot water is required in the mills for various processes. This water is now heated with live steam, which is supplied at each of the vats where the hot water is used.

There is available sufficient exhaust steam to meet all of the water-heating requirements. A study of the situation, however, disclosed that the fixed charges on the cost of installing the long runs of large-diameter pipe and the increased steam rates incurred because of the higher back pressure on the engines nullified the savings that would accrue from the use of exhaust steam for this purpose.

By installing open heaters at the East Main Street plant, near the source of the exhaust steam, and circulating the hot water at 228 deg. to the various parts of

the plant where it is used, costs were reduced to such an extent that the savings are expected to pay for the change during the first year's operation.

To detail the many minor changes, each of which contributed its share to the eventual result, would entail too great space for the telling, but among them are:

1. Stopping of steam and air leaks.
2. Replacing all damaged insulation on piping, valves, fittings and hot surfaces.
3. Periodic use of engine indicators and hand Orsats.
4. Checking incoming coal by screening and analysis.
5. Stopping air leaks in the furnace settings, breechings and baffles.
6. Reorganization of maintenance crew, minimizing outside repair men and concentration of authority and responsibility in the power house.
7. Conducting firing schools at both plants.
8. Better logging system for operation and maintenance.
9. Improved morale of plant organization.
10. Replacement of live by exhaust steam for building heating.
11. Reduction of light-load and stand-by losses on night and week-end loads.
12. Installation of slag-proof carborundum along clinker lines in both the hand- and stoker-fired plants.
13. Recalibration, rehabilitation and continued use of all available metering equipment.

The table gives average monthly operating data at one of the plants for three months prior to the start of the reconditioning program, and for comparison the operating results for the month of August, 1929. These data indicate that an increase of 8.6 points in efficiency has been obtained. The efficiency for the month is slightly high, as the average for the year was 73.5 per cent. This is a creditable boiler room performance when it is considered that no heat-recovery equipment is installed, the settings are low and the plant is twenty years old. Improved efficiency together with reduced boiler room labor have resulted in a saving during August of $3,770.51 at this one plant alone.

COMPARISON OF BOILER ROOM OPERATING AND COST DATA

| | Average Three Mos. 1928 | August, 1929 |
|---|---|---|
| Pounds of coal | 3,180,050 | 2,813,156 |
| Pounds of water evaporated | 27,154,000 | 26,570,000 |
| Average B.t.u. | 14,500 | 13,860 |
| Factor of evaporation | 1.17 | 1.14 |
| Equivalent evaporation per lb. of coal | 10.02 | 10.77 |
| Boiler efficiency, per cent | 66.7 | 75.3 |
| Wages, firemen | $1,225.62 | $845.85 |
| Repairs | 1,194.37 | 454.74 |
| Water | 294.26 | 265.55 |
| Coal | 9,260.26 | 6,639.05 |
| Supplies | 44.51 | 43.32 |
| Total boiler room cost | $12,019.02 | $8,248.51 |
| Saving per month | | $3,770.51 |

In a recent interview with Arthur Brewer, assistant works manager, he said: "When this waste-saving campaign started our primary interest was to solve the cinder nuisance, which cost us many thousands of dollars annually in spoiled work. We thought then, and we still believe, our former operations would rank well with the average of twenty-year-old industrial plants throughout the country. Not only did we accomplish what we started to do, but, much to our surprise, eventually secured undreamed-of benefits.

▼ ▼ ▼

## Cooling Unit Fabricated by Arc Welding Process

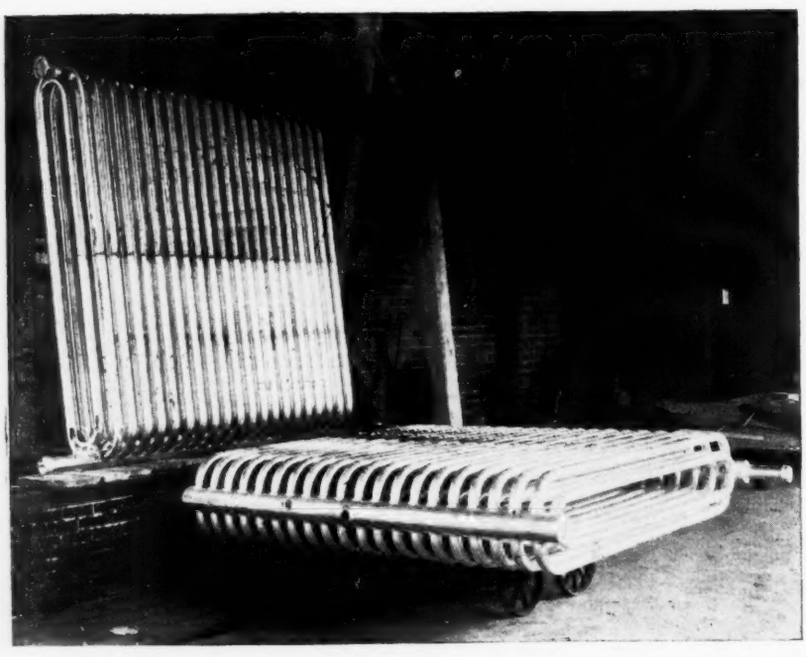
WELDING has made great progress in the refrigerating field, where tightness of the entire fluid system is a paramount requirement. The mechanical possibilities of welding have had, in turn, an important influence upon the design of refrigerating equipment, since good design must adapt itself to the method of fabrication. This trend is well illustrated by the cooling units shown in the accompanying photograph. These units, 9 ft. square, were fabricated entirely by arc welding. The procedure followed reflects the adaptability of the process and the ingenuity of the designer.

It will be noted that the coils (made of 2-in. pipe) are in two layers—inner and outer. Each inner coil is a complete loop formed by butt-welding the ends of two open U-shaped pieces. When a sufficient number of these loops have been prepared they are drilled at the ends and butted against holes drilled on the inner sides of the headers, to which they are then joined by arc welding. The headers are made of 5-in. extra-heavy piping.

With all the inner coils in place, holes are drilled in the headers for the outer coils (half loops), which are then welded in place.

To insure tightness, each cooling unit is given a hydrostatic test. While the carbon dioxide used in the system is not poisonous, it is costly and must not be wasted.

The photograph and information used in this article were furnished by the Lincoln Electric Company.



**Each of these all-welded units is 9 ft. square**

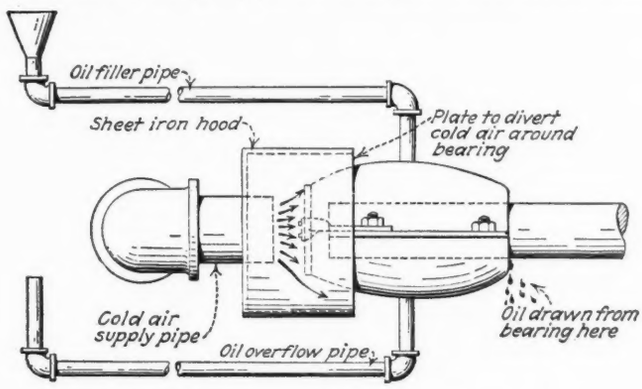
# . . . RIGHT OUT OF THE PLANT . . .

## How Trouble With Fan Bearing Was Eliminated

THE INSIDE bearing on a hot-air fan burned out several times, and it was thought possible that sand entering the bearing from the hot air duct was one cause.

A pipe from the outside with an elbow on the inner end, up fairly close to the bearing on the suction side, supplied cold air to the bearing, but it was thought that if a hood was built over the end of the bearing and connected to this pipe it would not only keep the sand away, but also would supply cooler air to the bearing.

The threads were found to be good in the elbow on the cold air supply pipe, so a nipple was screwed into


Oil filler pipe
Sheet iron hood
Plate to divert cold air around bearing
Cold air supply pipe
Oil overflow pipe
Oil drawn from bearing here

**How bearing was protected against dirt and cooled**

the elbow and a hood constructed from about No. 16 gage iron to fit over this nipple as shown.

This seemed to keep the sand away from the bearing and keep it cool, but it was then found that the suction of the fan was strong enough to draw the oil out of the bearing on the end next to the fan. A plate was fitted over the end of the bearing and fastened to one of the bearing cap bolts to divert the air around the outside of the bearing. This virtually cured the difficulty, but it was necessary to carry a slightly lower oil level than formerly.

Coffeyville, Kan. EARL PAGETT.

## Putting a Boiler Room Bonus to Work

WITH REFERENCE to the article on the boiler room bonus in the Jan. 28 number, there are undoubtedly many arguments for and against the use of a bonus. It is my opinion, however, that the fuel saving and improved boiler room conditions that would accrue through the profit to management alone would justify a boiler room bonus. There are, however, other advantages, besides actual profit, which are invariably overlooked.

The human element is still the most important in determining economy as well as the safety and dependability of the power plant. Experience makes a fireman, and the greater his experience and the more he plys and applies it, the more valuable he is to his employer. So, too, the more valuable he should be to himself. Few things are more damaging to morale, to dependable operation and economical performance than a high rate of labor turnover of the boiler room crew. By enabling the skilled man to earn more, the boiler room bonus reduces labor turnover. It promotes contentment and rewards ambition. The fireman is "kept on his toes" not because the boss is watching him but because his fellow workers insist that he does not pull the bonus down. When everyone is working for the same goal, the result is obvious.

The boiler room bonus need not be complicated to start or difficult to maintain. Nor is a heavy investment in instruments and equipment necessary to it. A bonus system may be started in any plant, from the smallest to the largest, on an investment ranging from $75 up to around $350, and a bonus is justified in any plant burning 10 tons or more of coal a day.

Instead of being something that requires a mathematician, a chemist or an accountant to devise and supervise, the more simple the boiler room bonus the better. That bonus is the most successful which permits the men to study it, understand it, watch it and foretell what they will earn. When men can do this they trust the bonus—and work to win it—where otherwise they would distrust and ignore it.

The firemen handle the coal. The way to save is to enable them to handle the coal more intelligently and conscientiously. Whether the coal is used wastefully or efficiently is shown by the $CO_2$.

A knowledge of $CO_2$ and a bonus or profit-sharing plan based upon $CO_2$ works wonders in a plant. The men quickly find out the effects of holes in the fire, thin or thick fuel bed and open doors, upon the $CO_2$—and their bonus! It is surprising how quickly they become skilled and adept at maintaining a higher average efficiency. Give the men a chart or table showing them the percentage of fuel loss for the different percentages of $CO_2$, pay them a bonus according to the average $CO_2$ per shift and it will be surprising how they can increase the percentage of $CO_2$. Of course, the maximum per cent of $CO_2$ that can be obtained depends to some extent upon the analysis of the coal; and the overall efficiency for any percentage of $CO_2$ will depend to some extent upon the stack temperature. Nevertheless,

the important thing is that the men handling the coal are "on the job," striving to save by operating their fires to the best of their ability. Pay each fireman a definite premium each day for the average percentage of $CO_2$ obtained.

A typical bonus based on the $CO_2$ is as follows: Average percentage of $CO_2$ per shift 14, daily premium per firemen 95c.; $CO_2$ 13.5 per cent, premium 90c.; $CO_2$ 13 per cent, premium 85c.; and so on down the line, making a reduction of 5c. per each one-half of 1 per cent decrease in $CO_2$

The premiums paid on this system show a 10 cent increase for every 1 per cent increase in $CO_2$, although the percentage of saving decreases rapidly as the percentage of $CO_2$ increases. The purpose of this bonus, however, was to bring about the highest efficiency possible rather than an improvement at the lower ranges.

Another typical bonus plan based upon $CO_2$ is as follows:

| Percentage of $CO_2$ per Shift | Daily Premium per Fireman |
|---|---|
| 9 to 10 | $0.25 |
| 10 to 11 | .40 |
| 11 to 12 | .60 |
| 12 to 13 | .90 |
| 13 & over | 1.25 |

The plant employing this system is paying each fireman an average of $5 to $6 a week additional, but saving many times that modest amount on the fuel bill.

These two instances show, surely, that a bonus system need not be complex or mathematical. The two typical bonus figures given have the advantage that the men themselves can watch their own performance and figure what they have coming.

Suppose one of these systems is checked up to see what the fireman gets out of it and what the management gets out of it. Suppose the fireman is able to bring up the average $CO_2$ during his shift from 9 to 12 per cent. This corresponds to a reduction in fuel loss from 7.58 per cent at 9 per cent $CO_2$ to 2.84 per cent loss at 12 per cent $CO_2$, a decrease in the preventable loss of 4.74 per cent. Suppose the fireman handles 10 ton of coal during the shift, coal costing $5 per ton. Then the waste at 9 per cent $CO_2$ during the shift is $3.79, while this waste was reduced to $1.42 by bringing up the $CO_2$ to 12 per cent. The difference between these two is a saving of $2.37 per shift. If the fireman is paid a bonus according to the first of the two systems given he receives a daily premium of 75c. when he maintains an average of 12 per cent $CO_2$, whereas he earns 45c. per day when the $CO_2$ averages 9 per cent. In other words, by bringing up the $CO_2$ 3 per cent and saving $2.37 per shift he is able to earn an additional 30 cents.

Chicago, Ill. K. RANKIN

# Natural Gas and Fuel Oil Compared

I HAVE READ, with interest, the excellent article on air supply when burning natural gas, by Erick Pick, in the Feb. 18 number of *Power*. The charts, Figs. 1 and 3 [of Mr. Pick's article and reproduced herewith as Figs. 1 and 2] will be of particular interest to the engineers of northern and central California, where, owing to the opening of the Kettleman Hills oil fields, natural gas is now available at a price comparing favorably with that of fuel oil.

In the past month I have received several requests from engineers in the North asking for data that may help them

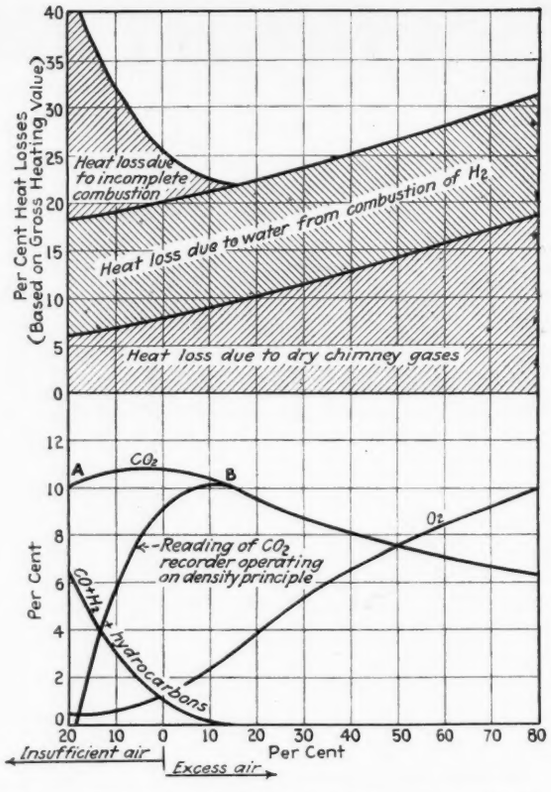



**Fig. 1—Flue-gas analysis and heat losses of a natural-gas-fired boiler**

in deciding which of the two fuels will give the best results. If the problem were a cost-per-B.t.u. question only its solution would be simple. However, several other items enter, which renders it more or less complicated.

The average heat value of the Los Angeles Basin natural gas, and, I believe, also that of the Kettleman Hills, is somewhat in excess of 1,100 B.t.u. per cubic foot. That of fuel oil in the same district is approximately 18,500 B.tu. per pound. A comparison of these values will show that on a B.t.u. basis each 5c. per barrel of oil is approximately equal to 1c. per 1,000 cubic feet of gas; that is, oil at 50c. equals gas at 10c.; oil at 75c. gas at 15c., etc. However, due to the difference of constituents of the two fuels, it is impossible to recover as much of the heat value of gas as of oil in the ordinary boiler furnace. This point is brought out clearly by A. Maies in *Power* of Jan. 28, and again in the charts by Mr. Pick. For all practical purposes, it may be assumed that the $H_2O$ losses are approximately twice as great with gas as with oil, and usually amount to 10 per cent of the heat value. Apparently, this item gives oil a decided advantage in cases where the B.t.u. costs of the two fuels are equal. However, there are several other factors that counteract these losses, and, in the final summing up, gas will be found to have the advantage over oil, even though its B.t.u. cost exceeds that of oil by 10 per cent.

Chief among the advantages of natural gas fuel as compared with fuel oil is the saving of 5 to 7 per cent of the total steam generated, which is used for pumping, heating and atomizing the fuel oil. While this estimate is high for the large central station, it is often exceeded in the smaller, less-efficiently operated plants. With fuel oil there is always more or less accumulation of soot, which is entirely absent with gas, except in rare cases of extreme negligence. The better heat transfer and the saving of steam and labor for soot removal gives

gas at least a 5 per cent advantage over fuel oil. Natural gas has a less destructive effect on furnace linings. Its absence from pulsation, the temperature and nature of the flame are such that furnace linings stand up much longer under gas fuel than with oil.

Also, there is the handling of the two fuels. Natural gas flowing through pipe lines directly to the meters (which, by the way, are usually very accurate and much simpler to obtain daily fuel consumption records with than are the average fuel oil meters) eliminates an elaborate system of tanks, pumps, heaters, etc., with their labor and maintenance charges. The cost and maintenance of automatic fuel control, the cleanliness, and more efficient combustion are all contributing factors which give natural gas an advantage over fuel oil when their apparent B.t.u. cost is equal.

I have had the opportunity of comparing the two fuels, used alternately, in the same plant on several occasions, and after due consideration I do not hesitate to recommend natural gas to the average small plant operator whenever its B.t.u. cost does not exceed the B.t.u. cost of oil by more than 15 per cent, and there are many instances where a greater difference in cost would be justified.

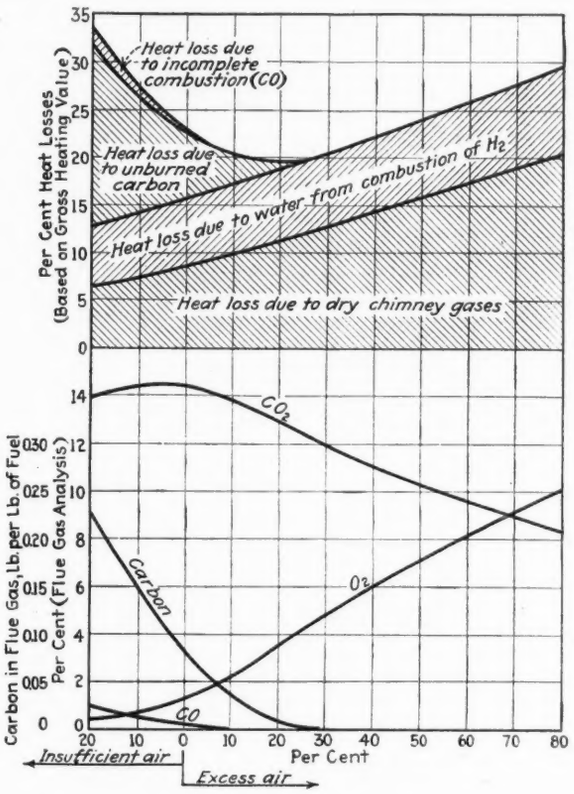

Heat loss due to incomplete combustion (CO)
Heat loss due to unburned carbon
Heat loss due to water from combustion of H2
Heat loss due to dry chimney gases
Per Cent Heat Losses (Based on Gross Heating Value)
CO2
O2
Carbon
CO
Carbon in Flue Gas, Lb. per Lb. of Fuel
Per Cent (Flue Gas Analysis)
Insufficient air
Excess air
Per Cent

**Fig. 2—Flue-gas analysis and heat losses of an oil-fired boiler**

Going back to Mr. Pick's article, and his reference to mine of June 18, 1929, the $CO_2$ recorder mentioned by me is of the volume-measurement, or chemical-absorption, type, and indicates the presence of CO and other unburned gases by the combustion of the same within the instrument, thus showing the presence of unconsumed fuel by an increase in the $CO_2$ present in each alternate sample of gas (one sample passing directly to the absorption solution, and the next one through a furnace before going to the solution, etc.).

With all due respect to the gas-density type of $CO_2$ recorders and their many advantages, it is evident that the chemical type of record referred to eliminates entirely the disadvantage mentioned by Mr. Pick, of the uncertainty of knowing whether the air supply should be increased or decreased when a low $CO_2$ is indicated. However, I admit that the almost total absence of lag in the gas-density type somewhat overcomes the disadvantage of its accuracy at all points below 10 per cent excess air, as shown in his chart.

A. C. McHUGH, *Chief Engineer*
Norwalk, Calif. Norwalk State Hospital.

# Proper Installation of Steam Gaskets

TROUBLE from improperly packed steam joints is a common occurrence in power plants of mills and other industries, and is a source of much waste of expensive packing material. Although the methods described here may be well known to older engineers, they will undoubtedly be helpful to younger engineers in the field.

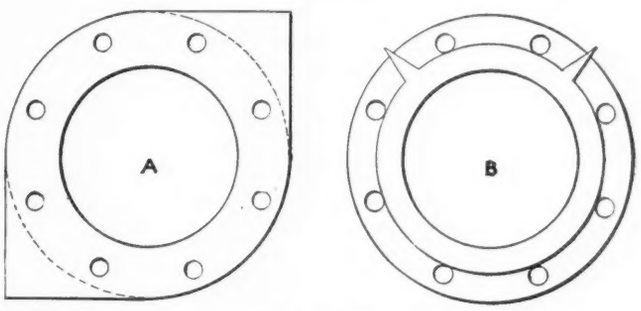
The view at *A* shows a typical incorrect method of installing gaskets on a steam pipe companion flange. A large piece covering the entire flange face is cut and the bolt holes punched. It is used principally because, in general, less skill is required to install it. The flange bolts are pushed through the gasket, and hold it in its correct position, until the other flange is bolted fast.

The view at *B* shows the proper method of installing a gasket. A ring is cut of not greater diameter than the inside tangent circle to the bolt holes, and small ears are left by which it may be located.

An advantage of this method is twofold. First, it saves, on a 6-in .pipe flange, a ring of packing 9-in. in diameter and 1½ in. in width, or about 42 sq.in. Second, gasket *B* is more effective than gasket *A*, for two reasons:

In gasket *A* the packing beyond the bolt holes is useless, because any escape of steam will take place through the bolt holes between the bolts and the flange. By reason of the smaller area of gasket *B* the unit pressure on it which may be produced by the bolts is more than doubled, and the chance for rupture under high pressure is considerably reduced.

An easy way of placing this gasket is to line up the bolt holes, slip in half of the bolts around the bottom,




**Incorrect and correct methods of installing pipe gaskets**

separate the flanges just enough for the gasket to be slid in with the help of the ears to guide it and then tighten a couple of bolts enough to secure it from slipping. The remaining bolts may then be put in and tightened up.

Butler, Tenn. W. S. WHITING, JR.

# From Among Readers' Problems

*Conducted by*
**L. H. MORRISON**

MOISTURE AFFECTS METER READING—*Assuming a constant flow of steam through a flow meter, would varying percentages of moisture affect the reading of the flow meter?* H.J.

The moisture in steam does affect the reading. A flow meter, although reading in pounds, actually measures volume of the fluid passing through the orifice. But as the meter constant is based on dry steam, to find the correct weight of the fluid passing we must multiply $W$, —the weight reading of the meter, by the ratio $\frac{d_1}{d}$ where $d_1$ is the density of the wet steam and $d$ the density of the dry, saturated steam, assuming the meter to be calibrated for dry steam. The result $W\frac{d_1}{d} = W_1$ is the weight of the mixture passing. To find the weight of the dry steam passing, the amount of the moisture indicated by the quality of the mixture must be taken from $W_1$.

—❖—

RETURN TRAP CONNECTIONS—*We are installing some machinery that requires a supply of live steam and will have return traps for returning the condonsation to the boiler, carrying 85 lb. pressure. One of the machines is to be supplied with steam reduced to the pressure of 30 lb. gage. How should the returns and trap be arranged and connected?* F.K.

All returns connected to a trap or receiver should be at the same pressure; otherwise those of higher pressure will prevent the trap from simultaneously receiving returns of lower pressure. Systems of returns that are at different pressures will require separate traps. The return pipes should be sloped so they will be drained perfectly clear of condensation and discharged by gravity to the trap, with the trap placed four feet or more above the boiler water line.

It is well to place an automatic air valve on the return line near the trap and also provide a pet-cock for testing whether the returns are being emptied. When the trap becomes filled with return water, the mechanism automatically admits live steam from the boiler for siphoning the water into the boiler, but cannot do so unless the receiver is elevated sufficiently for obtaining the necessary head of discharge water for overcoming friction of the trap discharge pipe and fittings.

There should be a separate return connection to the boiler, with check valve or connection so arranged that the discharge will not be affected by pulsations of a boiler-feed pump. The inlets and outlets for admission and discharge of return water, and for admission of live steam and discharge of displaced steam, are usually described in directions issued by the manufacturer or are indicated on the trap.

If the water inlet of the trap is not provided with a check valve, one should be placed in the return line near the trap.

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FLASHING OF WATER—*In a continuous blowdown system the water discharges from the boiler at 250 lb. gage, through an orifice into a receiver at 10 lb. gage. What percentage of the water flashes into steam?* C.A.D.

At 250 lb. gage pressure, the water leaving the boiler should be at the corresponding boiling temperature of 406.5 deg. F., and at this temperature it contains 380.7 B.t.u. per pound—this being the heat of the liquid measured from 32 deg. F. At 10 lb. gage, water boils at 240.1 deg. F., each pound of the water contains 208.4 B.t.u., and a pound of steam at this pressure will contain 1,160.4 B.t.u. If $X$ is the percentage of the water that flashes into steam, $(1 - X)$ remains as water. We can then write $380.7 = 1160.4 \frac{X}{100} + 208.4 \left(1 - \frac{X}{100}\right)$. Solving, $X$ is found to be 18+ per cent.

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SAFETY VALVES ON LOW-PRESSURE BOILERS—*We are operating a battery of boilers at 250 lb. gage and a battery at 90 lb. As the 90-lb. units do not give enough steam to meet the 90-lb. demand, we are drawing the balance from the 250-lb. line through a reducing valve. Should the low-pressure boilers have safety valves of sufficient capacity to care for the 250-lb. boiler?* C.R.V.

While various rules have been made on this point by different authorities, discretion should dictate the addition of enough 90-lb. safety valves to care for the capacity of the 250-lb. boilers. If this is not done and if the reducing valve should become inoperative, the full output of the 250-lb. boiler would pour into the 90-lb. header and the present 90-lb. safety valves would be unable to prevent overstressing of the 90-lb. boilers. However, the local boiler inspection bureau should be consulted as to the local specific requirements.

# PREVIOUS QUESTION

## *Discussed by Readers*

### THE QUESTION

*WE are building a 1,000-kw. 350-lb. plant and plan to weld the low-pressure piping. Is it advisable to also weld the high-pressure piping, and how can we know that the contractor is doing a good welding job?* C.M.V.

WELDING is one of the best methods for connecting a high-pressure steam line. A properly welded line is reliable, relatively cheap to install and will require practically no maintenance during the life of the pipe. The same cannot be said of any other type of pipe joint, especially when dealing with high pressures.

It is of prime importance to secure the services of a reliable welding contractor, one who has a good reputation and who can be depended upon. The welders' ability is of great importance, but that part is taken care of by the contractor.

To be sure of every welder's ability have each submit sample welds made on the same pipe as that which will be used on the job. While actual construction is going on, it would be advisable to note the methods the men use in lining up the pipe, the way they tack it, and the welding procedure. It is important that all of the pipe be beveled at the end and that the ends of the pipe be about $\frac{1}{16}$ to $\frac{1}{8}$ of an inch apart when the tack is

completed. If there is no space between the ends of the pipe it will be a hard task to secure full penetration, and the result will be a weaker joint than would otherwise be obtained.

The kind of rod to be used should be specified. It should be a rod made especially for securing strong, ductile welds in steel pipe. There are some rods which if properly applied will give the welded joint the strength of the pipe, and in many cases the joint will be even stronger than the pipe.

When the welder has completed the weld, he should reheat the first portion of the weld for a distance of about two inches to relieve the stresses set up by the cooling of this part of the weld. The contractor should test the finished line with 1,500 to 2,000 lbs. hydrostatic pressure. While under this pressure the pipe adjacent to the weld should be hammered with a small sledge. The reason for not hammering directly on the weld metal is that in so doing small pin holes may be closed and not show as leaks.

A welded joint is part of the pipe itself and therefore will last as long as the pipe. Furthermore it is easy to cover, presents a more pleasing appearance, and is lighter than any other kind of joint. Most important of all, with a welded joint there is freedom from all leaky unions, blown-out gaskets, and all of the other troubles that go hand in hand with other kinds of connections.

S. J. MASHL, *Welding Foreman,*
Van Schaack Bros. Chem. Works.
Chicago, Ill.

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WELDING of the high pressure piping would be advisable, not because of the pressure used, but because it would eliminate the inevitable leakage at the gaskets in a flanged joint, and the cost of the flanges and of fitting them would not be incurred. The equipment used for the work would be already on hand for the fabrication of the low-pressure piping.

A contract with the erector of the piping should set forth the welding procedure, the ability of the welder, and other necessary stipulations. These considerations, however, do not guarantee a good job, and hydrostatic tests should be applied to the piping as each section is completed. Or the job could be tested after completion.

Calgary, Canada. JAMES GRANT.

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HIGH-PRESSURE pipe may be welded as well as the low-pressure pipe, providing the welding is done by a competent man. The contractor should be required to give proof of the ability of his welders before any welding is done, by furnishing sections of pipe joints that have been welded. These test joints should show a minimum tensile strength of 45,000 lb. per square inch. The joint should stand a hydrostatic test of 1½ times safe working pressure. JOHN L. WHITE.

Lima, Ohio.

I RECOMMEND welding the high-pressure piping, except at joints that must be broken at intervals for overhauling or for making inspection. A welded-pipe job eliminates permanently most of the joints required with flanges, the necessity of packing at intervals and of keeping a stock of spare flanges, bolts and gaskets on hand. It not only does away with possible leakage losses, but also with radiation losses from exposed flange surfaces. When a leak occurs in a flanged joint around the threads, it is necessary to remove the pipe covering for several inches back from the joint, to prevent it from becoming water soaked, until the pipe can be taken out of service to repack the joint. This additional exposed surface is the cause of noticeable radiation loss. Eliminating flanges also makes it possible to locate the pipe supports wherever desired.

To make sure of the quality of work done by the contractor, the owner should employ a competent welding inspector. Before the work begins, he can determine the ability of the welders by requiring them to make a number of test welds. He should make sure that pipe ends are thoroughly cleaned and turned to the proper bend and that pipe sections are properly lined up. As work progresses, he should see that the deposited metal in the welds is of good quality, and not burned or spongy. When the job is completed, the piping should be filled with water and subjected to a hydrostatic test in accordance with the inspection code under which the work has been authorized.

HOWARD LIVINGSTON.
Los Angeles, Calif.

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I FELT sure that the question would interest my friend Frank Groves, an engineer who has had a long and varied experience with gaskets. Mr. Groves is on the road much of the time in connection with piping work in industrial and power plants, and so I clipped out the page and sent it to him.

Here is what he wrote to me regarding the question:

"It is rather difficult to go into the matter very deeply without mentioning names of individuals and plants, and to do that might cause offense. I was just down at one of America's largest power plants this morning and found that on the last construction job the joints were all gasketed. They have had no trouble with this installation, whereas they had had plenty of trouble on the previous job, which was welded.

I find that a number of construction engineers have changed their specifications during the last eighteen months and are now specifying gaskets again, for all pressures, where they had been using welded joints.

There is no way that I know of whereby the engineer can be certain whether or not the contractor is doing a good job of welding except the test of regular operating conditions. However, no matter how well the welding job is done, there is always danger of leakage.

During a test made by a certain prominent manufacturing company, half of the welded flanges leaked under the hydrostatic test, and as this was a test of their own fittings the best of workmanship was no doubt employed. The metal gaskets used under steam pressure up to 1,000 lb. in the same test did not show any leakage.

Newark, N. J. W. F. SCHAPHORST.

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IF MONEY is available and high-pressure piping can be welded, I would weld all the piping, except where it is bolted to the machine, the boiler and the condenser.

My reason for thinking that welding is advisable is that trouble with gaskets blowing out will be eliminated, and hence one cost of maintenance will be avoided.

If it is desirable to weld low-pressure or return piping I cannot understand why equal advantage would not result by welding the high-pressure piping as well.

The only logical way of ascertaining if the contractor is doing a good job is to put the whole work under a hydrostatic test on exactly the same terms as we test boilers, namely, by using 1½ to 2 times the allowable pressure on the piping. Of course care must be taken to see that the lines to be tested are properly blanked off from the machine or other parts not being tested.

I would strongly advise that the electrical welding process be used rather than the oxy-acetylene method, as the latter makes the fused metals too hard, especially at the junctions. Electric welding does not have this fault.

Washington, D. C. WM. H. DALLY,
*Assistant Engineer,*
McKinley High School.

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IT IS good practice to weld the high-pressure piping if it can be done properly. But the only way to secure a good welding job from the contractor is to furnish a detailed drawing of the piping and have the pipes cut to proper length and beveled to a desired angle in local shops. Then employ a welding contractor to do the job.

New York City. STEPHEN KULISH.

## A Question for Our Readers

*HOW can I calculate the piston speed and mechanical efficiency of a simplex and duplex steam pump?* L.M.B.

Suitable answers from readers will be paid for and published in the April 22 number.

# *Welding Specifications for Power Boilers*

## *Published for Discussion*

▼

**The suggested code here reproduced is purely tentative and is made public by the A.S.M.E. Boiler Code Committee to encourage extensive discussion before any official action is taken. *Power* will be glad to publish suitable brief discussions. Copies of original manuscripts will be forwarded to the code committee.**

▼

IT IS THE policy of the Boiler Code Committee to receive and consider as promptly as possible any desired revision of the rules and its codes. Any suggestions for revisions or modifications that are approved by the committee will be recommended for addenda to the code, to be included later on in the proper place in the code.

The boiler code committee has received and considered suggestions for proposed specifications for fusion welding of drums or shells of power boilers. This movement is a result of the inadequacy of both riveted and forge-welded construction for such durms or shells for boilers to operate at from 900 lb. to 1500 lb., unless the diameters are kept down to impracticable limits. On the other hand, recently, refinements in the application of fusion welding have made practical the welding of drums and shells of plate thicknesses up to 3 in. or more, and vessels constructed in this manner have been successfully used in large numbers in connection with petroleum-refinery equipment. The proposed specifications which are now under the joint consideration of the American Welding Society and the Boiler Code Committee are submitted below for criticism and comment thereon from any one interested. Discussions of the proposed specifications should be mailed to the Secretary of the Boiler Code Committee, 29 West 39th St., New York, N. Y., in order that they may be presented to the committee for consideration.

### Proposed Specifications

1. Drums or shells of power boilers may be welded by the fusion welding process when materials suitable for welding are used in accordance with Pars. S-5 to S-17, or S-264 to S-279, of Section II of the code, and provided the following requirements are fulfilled.

2. *Test Plates for Longitudinal Joints*—Two sets of test plates from steel of the same heat as the drum plates, prepared for welding, shall be attached to the shell being welded as in Fig. 1, one set on each end of one longitudinal seam, so that the edges to be welded in the test plates are a continuation of and duplication of the corresponding edges of the longitudinal seam in the shell. Weld metal shall be deposited in the test plates continuously with the weld metal deposited in the longitudinal joint of the shell. (Note: Recommendations have been made that as an alternative, the test specimen be allowed to be cut out of the welded longitudinal joint at any point, and the hole thus made welded up afterward if the tests of the specimen show the vessel to be acceptable.)

3. *Test Plates for Circumferential Joints*—When test plates are welded for the longitudinal joints, none need be furnished for circumferential joints in the same vessel. Where a drum has circumferential joints and no longitudinal joint, a set of test plates of the same material as the shell shall be welded in the same way as the circumferential joint. (See note under Par. 2.)

4. *Stress Relieving*—The complete welded structure or such parts welded separately as may be later assembled by means othe than welding, shall be heated uniformly to at least 1,110 deg. F. The structure shall be brought slowly up to the specified temperature and held at that temperature for a period of at least one hour per inch of thickness, and shall be allowed to cool slowly in a still atmosphere. The test plates shall be subjected to the above stress-relieving operation either attached to or placed within the parent vessel.

5. *Test. Specimens*—The inspector shall select one of the two welded test plates, from which the coupons for tension, impact, and bend tests and for macro and micro examination shall be removed as shown in Fig. 2.

6. *Tension Tests*—The tension specimen shall be traverse to the welded joint, and shall be the full thickness of the welded plate after the outer and inner surfaces of the weld have been machined to a plane surface flush with the plate. When the capacity of the available testing machine does not permit of testing a specimen of the full thickness of the welded plate, the specimen may be cut with a thin saw into as may portions of the thickness as necessary, each of which shall meet the requirements.

Each tension specimen should fail in the boiler plate, but if failure occurs in the weld metal or along the line of fusion between weld metal and the plate, then the tensile strength shall not be less than the minimum of the specified tensile range of the plate used.

7. *Bend Tests*—The bend-test specimen shall be transverse to the welded joint of the full thickness of the plate and shall be of rectangular cross-section with width 1½ times the thickness of the plate. When the capacity of the available testing machine does not per-

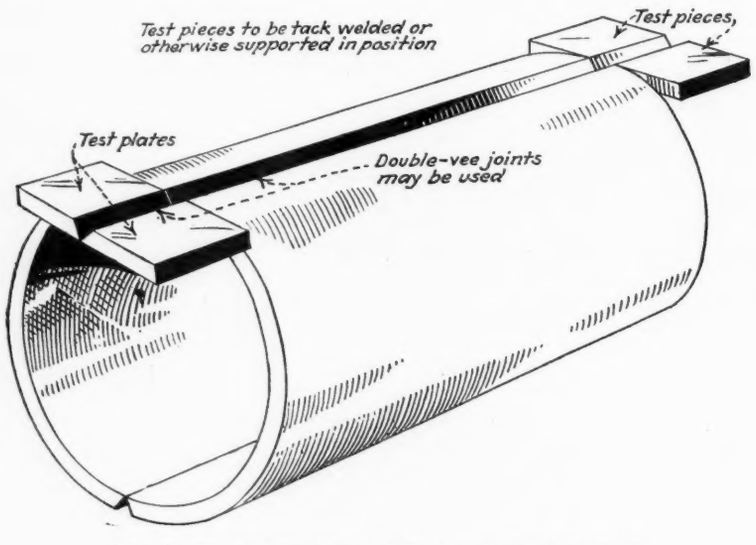



**Fig. 1—Sketch Showing Test Plates Attached to Shell**

mit of testing a speciment of the full thickness of the welded plate, the specimen may be cut with a thin saw into as many portions of the thickness as necessary, each of which shall meet the requirements. The inside and outside surfaces of the weld shall be machined to a plane surface flush with the plate. The edges of this surface shall be rounded to a radius equal to 10 per cent of the thickness of the plate. The specimen shall then be bent cold under free bending conditions until the least elongation between any two points within and across the weld on the outside fibers of the bend-test specimen is 30 per cent, with the width of any surface cracks deducted. No surface crack shall be longer than 10 per cent of the specimen's width, when the elongation of the outside fibers has reached 10 per cent.

8. *Impact Tests*—Three coupons for impact tests shall be taken transverse to the welded joint and prepared so that the cross-section of the specimen through which fracture will occur shall contain: (1) the bottom surface, (2) the middle section, and (3) the top surface of the weld. The notch in the bottom specimen shall be opposite the bottom surface, and in the top specimen opposite the top surface. The minimum value of the impact test shall be 20 ft-lb., standard A.S.S.T. Charpy impact specimen.

9. *Chemical Analyses*—Drillings from the weld metal representing an average sample shall conform to the following requirements:

| | |
|---|---|
| Manganese | 0.30–0.60 per cent |
| Phosphorus | Not over 0.04 per cent |
| Sulphur | Not over 0.045 per cent |
| Nitrogen as iron nitride | Not over 0.020 per cent |

The nitride content shall be determined by the modified Allen method of the Bureau of Standards (Scientific Paper No. 457, United States Bureau of Standards). (NOTE: A majority of those who have been consulted consider this test unnecessary.)

10. *Macro and Micro Examinations*—Macrographs prepared from coupons taken across the welded joints and etched with suitable reagents shall show no laps, excessive porosity, nor incomplete fusion. Micrographs of polished specimen taken in the same manner shall show no evidence of coarse-grained material. (NOTE: A majority of those who have been consulted consider this test unnecessary.)

11. *Retest*—Should the bend or impact tests fail to meet the requirements by more than 25 per cent, retests shall be allowed on specimens cut from the second welded test plate. These retests shall comply with the requirements. Should any of the original tests fail to meet the requirements by 25 per cent or more, no retests shall be allowed. If the tension test fails to meet the requirements, additional tension tests shall be allowed on two specimens cut from the second test plate and both of those shall meet the requirement.

12. *Non-Destructive Tests of Vessel*—The welded joints of the annealed structure shall be explored by an approved recording non-destructive test, such as an electrical or magnetic fissure detector or X-ray apparatus, which will determine quantitatively the size of a defect. (NOTE: A majority of those who have been consulted consider this test unnecessary).

13. *Fatigue Tests*—The annealed vessel shall be subjected to 10,000 cycles of pressure, each cycle varying from zero to 1½ times the working pressure. These cycles of pressure should preferably be applied at the rate of 10 to 12 per minute.

The welded joints shall then be again explored by approved non-destructive test apparatus. The second set of readings shall show that no change in the welded joints has occurred during the fatigue test. (NOTE: Objections have been raised against this test by those who consider it unnecessary or capable of dangerously affecting the structure.)

14. *Holes*—No holes shall be located in a welded joint. When holes in the plate are located near a welded joint, the minimum distance between the edge of a hole and the edge of a joint shall be equal to the thickness of the plate, when the plate thickness is from 1 in. to 2 in. With plates less than 1 in. thick, this minimum distance shall be 1 in. With plates over 2 in. in thickness, the minimum distance shall be 2 inches.

15. *Allowable Working Stress*—When constructed under the above provisions, the maximum unit working stress of a welded joint may be taken as one-fifth of 80 per cent (16 per cent) of the minimum of the specified tensile range of the plate used. (NOTE: Criticisms have been received which claim that the maximum unit working stress allowed should be from 90 to 100 per cent of the minimum of the specified tensile range.)

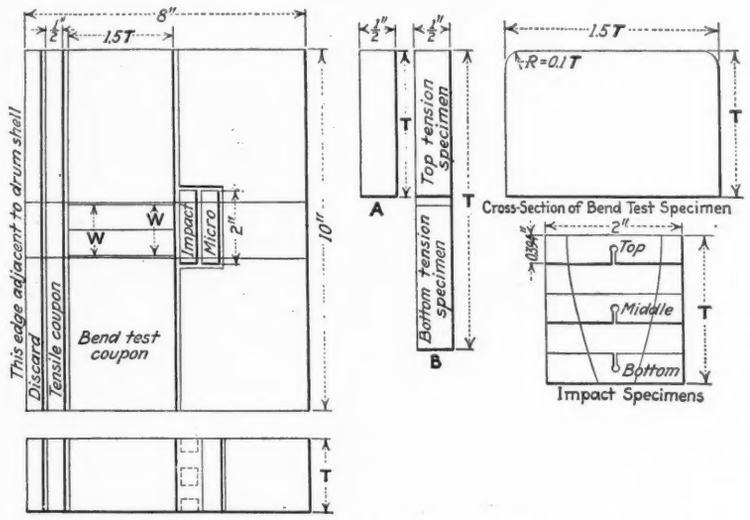



**FIG. 2—TEST SPECIMENS FROM WELDED TEST PLATE**

*A* = Cross-section through tension specimen.
*B* = Cross-section through tension specimen parted in two.
*T* = Thickness of plate.
*W* = Gage length on bend-test specimen.

## Methods of Protecting Transmission Lines

THE many protective gears available for use on modern power transmission systems were discussed in a recent lecture in London by T. W. Ross and H. G. Bell. In the difficult problem of making a choice it may be necessary to take into account the liability of the feeder to breakdown, the existence of an alternative route of supply, the importance of the load and the liability of a fault to cause extensive disturbance.

In the United Kingdom balanced protective gear has been virtually standard on short feeders which have been in service. The greater distances which have now to be covered by feeders render the cost of the pilot wires and special cables, required by balanced protection systems, prohibitive in many instances, and consequently non-pilot methods not requiring special cables must be used in many installations. It is, however, desirable that such methods should give protection comparable with that obtainable on shorter feeders, in the opinion of the lecturers quoted.

The capital cost and maintenance charges on protective gear are generally regarded as a type of insurance premium, and the amount of money allocated for this purpose will largely be determined by the value placed upon the continuity of supply at all points.

✦

NEW ORDERS for 942 steel boilers were placed in January, as reported to the Department of Commerce by 81 manufacturers comprising most of the leading firms in the industry, as compared with 1,029 boilers in December and 1,075 in January, 1929.

# *Keeping Hydro Equipment Free of Ice*

## *Discussed at Chicago Meeting*

**N.E.L.A. Hydraulic Power Committee also considers the problems of governing hydro-electric units and of applying automatic frequency control. The findings given in a report on the reliability of hydro-electric units and another on welded pipe are included.**

AT THE Edgewater Beach Hotel, Chicago, Ill. March 10 to 13, the Engineering National Section Committee meetings of the National Electric Light Association, were held. At the Hydraulic Power Committee meetings reports were presented on ice problems; hydraulic governors and frequency control; reliability of hydro-electric units; and welded pipes. In addition, short papers on other subjects were presented and discussed. At the fourth session of the committee, Byron E. White, chairman, presided.

H. F. Roberts, chairman of the sub-committee on ice problems, presented a report on how these problems are handled at a number of plants in Canada. Attention was called to how, in a normal winter, sluice gate will freeze in solidly and a wall of ice almost as thick as the surface ice will form across the full face of the gate on the upstream side. This causes serious damage and buckling of the skin plates on the gates. In some cases the ice has been so thick and strong that in the spring after the gates had been thawed clear and lifted, it would stand the full head of water without failing. Three different methods of keeping sluice gates free of ice were suggested:

1. The downstream faces of the gates are housed with timber sheeting, in some cases two layers of sheeting with insulating material between, and either electric- or steam-heating coils are placed inside of the gate. In some cases blowers are provided to circulate warm air to keep all parts of the gate at an even temperature.

2. The embedded parts which form the seat for the gate and which transmit the load from the gate to the concrete are made with a hollow section, and either steam pipes or electric heaters are placed in these to keep them warm.

3. Air bubblers are installed in the water just upstream from the gates to maintain a circulation of warm water from the lower part of the pond up along the face of the gate to the surface. In several cases combinations of the three methods outlined have been used with apparent success.

Where flashboards are used, to prevent the ice from displacing them, it is considered necessary to maintain an open water channel along the upstream face of the boards. Three methods were reported for doing this:

1. Cutting open channels along the upstream face of the flashboards, either by hand or by the use of steam-jet ice saws.

2. By installing bubblers along the upstream face of the flashboards, air released by the bubblers bringing warm water to the surface, and thus keeping a channel open.

3. By electric heaters or lights arranged under reflectors which direct the heat down and prevent ice's forming under the heaters along the face of the flashboards.

With the present cost of labor the expense of cutting an open channel with saws and other tools was considered extremely high, even with the steam-jet saw, which can cut 40 ft. of 38-in. thick ice per hour. It was considered possible to maintain an open channel with either a high-pressure or a low-pressure air bubbler system with as low as 300 to 400 watts of energy per foot of channel. The low-pressure system was considered the better.

ATTENTION was called to two installations of electrically heated racks that are operating successfully. In one case the intake racks for units rated at 43,000 hp. under 143-ft. head are kept free of ice by the expenditure of 400 kw. per unit. This is equivalent to 121 watts per sec.-ft. of water taken by the wheels at full load, and is sufficient to raise the water's temperature 1/540 deg. F. only.

Where the load varies widely it is considered feasible to operate a large surge tank without either insulating or heating. Small tanks or tanks with small risers require housing. Putting the heat directly into the water is the preferred method. One system of doing this is to use a small pump to take the water from the tank's bottom and force it through an electric boiler and to the top of the tank, where it is sprayed on the water's surface. In another installation electric heaters are immersed near the surface of the water by attaching them to the bottom of a float, free to rise and fall with the water.

A COMPREHENSIVE report on hydraulic governors and frequency control was presented by E. B. Strowger, chairman of the sub-committee on hydraulic governors. It considered fundamental principles underlying the design and operation of hydraulic governors which may influence the application and operation of any method of frequency control; the question of frequency control as developed to date; economical distribution of load on various units of a system; instability of hydro-electric units as related to the governor; hydraulic units without governors; recent developments in hydraulic-governor design; and governor maintenance.

In a discussion of the fundamentals of regulation of hydraulic units it was shown that on a given system the causes of momentary frequency fluctuation are the impulses given to the various rotating elements by load changes accompanied by water-hammer phenomena in the penstocks; and the load characteristics of the system, which may be such that load changes are induced on the system when the speed fluctuates. It is imperative that service not only be continuous, but it must be supplied at constant voltage, constant frequency and in the most economical manner. It was pointed out that constant voltage has received the most attention, but the other two factors are now being given greater consideration than heretofore.

AUTOMATIC frequency control corresponds to hand operation when the operator exercises constant vigilance to hold the speed of the units regular. Two methods of doing this were described in the report. The first method employs a contact-making frequency meter, a Leeds & Northrup Company product, with contacts set 1/20 cycle above or below normal. When the frequency varies 1/20 cycle from normal value a contact closes and an impluse to change the position of the gate or valve is sent to the synchronizing motor on the governor. The length of these impulses is proportional to the amount that the frequency departs from normal.

A second system is that developed by the Warren Telechron Company working with General Electric Company. In that system the average speed of a small synchronous motor connected to the power lines is checked every two seconds with the swing of a pendulum. If the synchronous motor has not made

the right number of revolutions during the two-second interval, a correcting impulse is sent to synchronizing motor.

THERE are a number of practical considerations that must be studied before frequency can be controlled successfully. One is termed "variation characteristic" of the system and is defined as the amount and ratio of load change during normal operation exclusive of emergencies. This may be expressed in kilowatts per second, or total kilowatts change in a given time. Another is termed "sensitivity characteristic" of the system and is defined as the degree of speed change which will cause the generating units to pick up a drop load based upon normal sensitivity of the governing equipment on the units. This is expressed as an increment of frequency above and below normal.

A THIRD consideration is called the "speed characteristic" of the system and is defined as the rate of change of demand in kilowatts with respect to a given change in speed. It may be expressed as the variation in output as sum function of speed. With a lighting load the power output would be very little affected by a change in speed, where with a centrifugal pump load the kilowatts output of the generating units would approximate the cube of the speed.

REGARDING how good instantaneous frequency should be to satisfactorily operate some of the present interconnected systems, 1/20 of a cycle above or below normal seems to be the goal, according to the report. Limits of variation of frequency have come to be far beyond limits of regulation of an ordinary governor. It is claimed that for multiple frequency control 1/1000 cycle is the limit of sensitivity.

Attention was called to the fact that the smaller the tolerance set for frequency control applied to hydro units on a given system, the greater will be the rate of movement of the turbine gates and the consequent wear that may be caused by incessant motion. This item, it was cautioned, should not be overlooked, as it may increase the outage due to wear of parts and cause more frequent repairs.

Emphasis was laid upon the desirability of maintaining rigid schedules for unit loading in order to reduce to a minimum the prime mover operating losses. The factor of maximum economy is an important element affecting constant frequency. It is possible to maintain constant frequency, but at an expense that far outweighs its intrinsic value.

THE DESIRABILITY, in large interconnected systems, of assigning the task of frequency regulation to low-head run-of-river hydro plants was shown. In this connection the statement was made:

"The low-head hydro plant of the future will, by assuming the maintenance of frequency, be in a position to iron out annoying fluctuations of load which greatly reduce the efficiency of steam stations, and thus will lead to better economy of fuel-burning plants. It appears, therefore, rather ironical that hydro should improve the operating conditions, not only by bettering the load factor, but also by carrying the swings, and then should have to meet the claims of steam engineers who say that they can reduce the cost of steam to a point where it is no longer feasible to build hydro plants.

"It may be difficult to see the connection between frequency regulation and peak service rendered at times of insufficient river flow. However, it should be considered that hydro ought to be given credit for the difference between the instantaneous system peak and the constant steam line below which the steam plants operate. It is evident, therefore, that if the swings are carried by the hydro plants, the credit which hydro may earn, having given a definite amount of available energy for minimum stream flow, will also be increased."

DISCUSSING the report, the point was made by C. F. Merriam that in low-head plants with storage facilities it may be advisable to use units of different size, so that load swings may be handled more economically by units of capacities comparable to the swing load requirements.

The report stressed the proper maintenance of hydraulic governor systems. Lost motion may develop sufficiently through wear, or governor parts may be bent so that the governor begins to hunt. New parts should be installed as soon as good judgment based upon a careful inspection dictates. Many companies are reluctant to make necessary governor repairs until an outage impends from that source. A lax policy in this regard may increase the time required by operators to synchronize and may prove to be both expensive and annoying.

P. M. GROVER of the United States Geological Survey talked to the Hydraulic Committee on the work that the Survey is doing with rainfall-gaging stations. It operates 1,700 gaging stations and co-operates with the army engineers in the operation of 500 more. About September, 1931, the Survey plans to take over all the gaging stations now under the control of the army engineers. The Survey also tries to co-operate with the states, but several of them fail to respond in this work. On this account and because of the lack of funds many state gaging stations may be abandoned.

Attention was called to the difficulties of establishing a ratio between rainfall and runoff. Mr. Grover said he had found that if about 21 in. is subtracted from the yearly rainfall before attempting to establish a runoff ratio, the results obtained are more consistent.

A report presented on the breathing of penstocks, by Joel D. Justin, showed that there are no cases of penstock failure from breathing. In addition to the breathing of the penstock there are vibrations reflected back from the unit when in operation. No effects have been found that would warrant the belief that these vibrations fatigued the metal in the penstock beyond the point of safety.

A REPORT, by Frank K. Nash, on the use of vacuum breakers on hydro-electric units used as synchronous condensers, was read. By breaking the vacuum in the draft tube, in one instance, power required to operate the units was reduced from 20 per cent to 5 per cent of the machine's rating. In another plant a unit required 5,000 kw. to operate with vacuum in the draft tube and 400 kw. when air was admitted. Attention was called to the difficulty experienced with water remaining in high-head wheels even when the vacuum is broken. Gate leakage is held in the wheel by centrifugal force. Under normal operating conditions, with low-head wheels, the 7 or 8 per cent leakage through the gates was considered sufficient to lubricate the seal rings when the units are operated as synchronous condensers.

Farley C. Ralston, chairman of the sub-committee on reliability of hydro-electric units, presented the committee's report on 191 units in operation in 1928. They represent a total of 4,202,300 hp., or an average rating of 22,002 hp. All of them are of modern design, having been installed since 1919. They averaged a total outage time from all causes of 3.52 per cent and an outage time when in demand of 0.78 per cent. Corresponding values for 207 large steam turbine units in the same year are 9.69 and 2.74 per cent, respectively. The service demand availability factor for the two classes of units is given as 99.07 for hydro and 96.06 for steam.

Taking the total outage time as 100 per cent, 11.76 per cent is due to hydraulic causes outside of the plants; 54.57 per cent is chargeable to the waterwheels and their auxiliaries; and 33.67 per cent is accounted for by the generators and their appurtenances.

PROF. G. BROWN reported the results of an investigation of welding waterwheel runners. It has been found that restoring runners to their normal condition frequently increases their output, on the same volume of water, from 2 to 5 per cent. The cost of welding was approximated as $5 to $6 per pound of metal deposited.

AN INTERIM report was given by C. B. Hawley, chairman of the subcommittee on welded pipe. The conclusion drawn in this report was that, while it is the opinion of many of those contributing information to the committee that welding will be more generally used in the future in penstock construction, the use of countersunk rivets and the development of large seamless tubing and banded pipes is tending to postpone the economic need for immediate further improvement in the process of electric welding as applied to hydraulic pipe lines.

# WHAT'S NEW IN PLANT EQUIPMENT

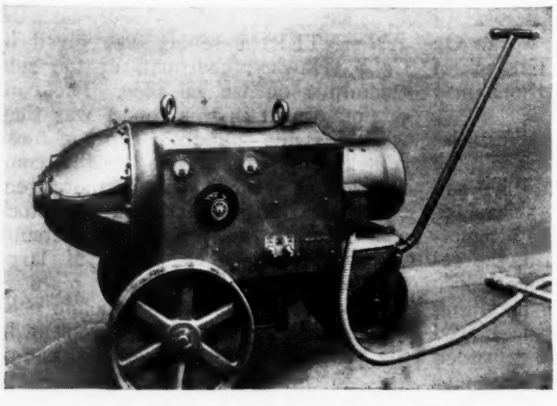
HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING, TRANSMITTING AND APPLYING THE POWER SERVICES

## New Welder Eliminates Explosive Arcs

AN ENTIRELY new principle has been incorporated in a new line of arc-welding machines, designated "Flex-Arc," recently brought out by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., which, it is claimed, makes it much easier for the operator to strike and maintain the arc under all operating conditions, and eliminates explosive arc characteristics.

The improvement in the new welding machine characteristics is obtained by the use of a special piece of apparatus, known as a "flexactor," replacing the reactor formerly used. The chief function of the "flexactor" is to prevent the overshooting or abnormal rise of current and resultant tendency of the electrode to stick. In addition, it corrects for lengthening of the arc, which causes the current to momentarily drop below the normal steady value and interrupt the arc, as well as eliminating the explosive action caused by globules of metal passing across the arc.

Extraordinary arc stability and flexibility over the entire current range, both at extreme low- and high-current values are claimed for the new welder. Other features of the machine are drip-proof compact construction, mobility, wing-nut terminals for welding cable connections, single rheostat adjustment, and high over-all efficiency.



In this new welder a flexactor replaces the reactor formerly used

## Ten-Ton Overhead Crane of Aluminum Alloy

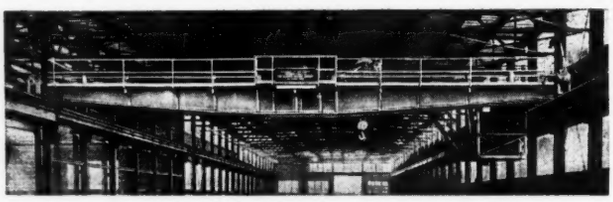
ANY reduction in the dead weight of a traveling crane that might be made through the use of lighter alloys or improvements in design not only increases the capacity of the crane for work, by permitting it to be spotted more quickly, but also makes possible a considerable saving in the construction costs of the runway and supporting members.

With a view to determining the possibilities of a lighter-weight crane, there has been installed in the new structural mill of the Aluminum Company of America at Massena, N. Y., two ten-ton cranes on the same runway. One of the cranes was fabricated from aluminum alloys of the duraluminum type, and the other is of standard steel construction. Both were built by the Alliance Machine Company, Alliance, Ohio.

COMPARATIVE WEIGHTS OF ALUMINUM AND STEEL 10-TON CRANES

| | Aluminum Crane, Lb. | Steel Crane, Lb. |
|---|---|---|
| Weight of trolley, including motors, brakes, etc. | 16,000 | 16,000 |
| Weight of main girder, including shafting, pedestals, walkway, rail, etc. | 14,100 | 24,000 |
| Weight of bridge motor and supports | 3,900 | 4,800 |
| Weight of auxiliary girders, including weight of conductor angles, brackets, etc. | 11,900 | 20,200 |
| Weight of end carriages | 15,000 | 15,000 |
| Weight of operator's cage, including controls, etc. | 3,200 | 5,000 |
| Miscellaneous items | 2,900 | 6,000 |
| Total weight of crane | 67,000 | 91,000 |

Briefly described, the aluminum alloy crane is a three-motor, single-hook machine with a lift of 22 ft. The bridge is fabricated from two double-web girders spaced 7 ft. on centers. The girders are constructed of strong aluminum alloys, and have a span of 72 ft. 2. in. Aluminum was also used in the walkway, handrails and operator's cage. The bridge girders frame into cast-steel carriages at each end, and a one-piece cast-steel trolley carrying the hoisting mechanism is mounted on the girder rails.



Aluminum alloy crane with 72 ft. span

Design of the aluminum alloy crane is based largely upon the usual practice followed in building steel cranes, although certain departures were necessary in the case of the bridge girders. While the strength of structural steel and of the strong aluminum alloys is approximately the same, the modulus of elasticity of aluminum is only one-third that of steel. For this reason, the girders on the aluminum alloy crane were made with a section somewhat deeper, wider and greater

in area. They were also constructed with about twice as much camber as was employed on the steel girders.

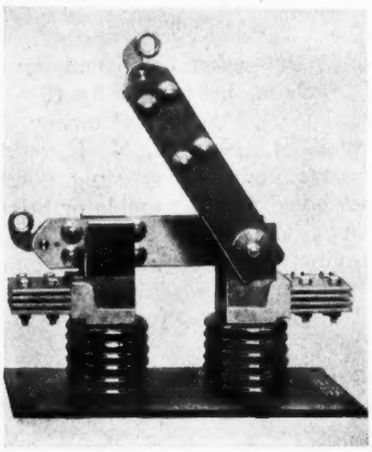
The accompanying table shows the comparative weights of the two cranes and indicates a saving in weight of 26.4 per cent when using the same crane trolley and end carriages on the two cranes. It is pointed out by the manufacturer that a redesign of these two members, using aluminum alloy where possible, would increase the saving in weight on the complete unit to about 40 per cent.

Tests made for deflections and permanent set, if any, under load indicated that the deflection of the aluminum alloy crane was about 1.8 times as much as that of the steel crane when a 25 per cent overload was applied at the center of the span, and when subjected to a load of 34,500 lb., or a 72.5 per cent overload, there was a deflection of only 1.09 in. If any permanent set occurred, it was less than 0.02 in. and may be considered as negligible.

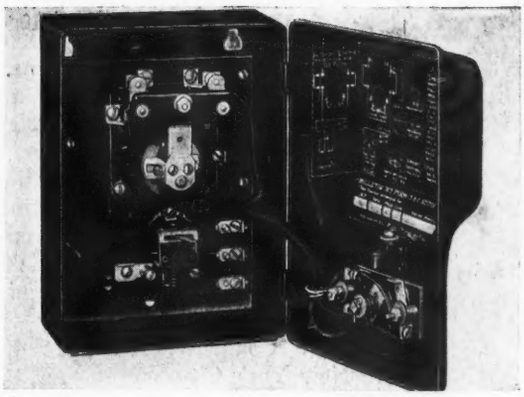
## Double-Blade Disconnecting Switch

THE Delta-Star Electric Company, 2400 Fulton St., Chicago, Ill., announces an improved line of double-blade tongue-type indoor disconnecting switches—a 15,000-volt, 3,000-amp. two-blade type being illustrated.

Each set of separately operated blades is equipped with positive safety locks. Terminals can be provided for flat or round bars, solid or stranded wire or copper tubing. The insulators are wet process, dark brown glaze porcelain of high mechanical strength.



**Switch with one blade open**



**Single-phase starting switch for motors governed by either two- or three-wire control**

## Starting Switch for Single-Phase Motors

ALLEN-BRADLEY COMPANY, 286 Greenfield Ave., Milwaukee, Wis., has introduced a single-phase starting switch (Bulletin 707) for motors operating compressors, pumps, oil burners and similar motor-driven equipment governed by either two- or three-wire control.

It is a double-pole magnetic switch with thermal overload relays and with maximum rating of 1½ hp. 110 volts, and 3 hp. 220 volts. An important feature of this starting switch is that the operating coil has a double winding for series-parallel connections, permitting the switch to be used interchangeably up to and including 1½ hp. for 110- or 220-volt motors by simply changing the terminal connections of the operating coil. This increases the flexibility and reduces the number of switches to be carried in stock to meet normal requirements. It can be furnished with start and stop push buttons in the cover, without push buttons, and with two-way lever switch.

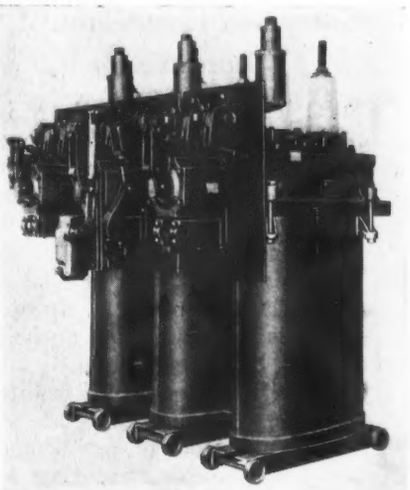
## Indoor Oil Circuit Breaker

A NEW indoor oil circuit breaker, type F-114, for the control and protection of generators and feeders in central stations and for use in industrial plants where the service is severe is announced by the Condit Electrical Mfg. Corporation, Boston, Mass.

The frame is especially designed for rigidity to assure proper functioning of the mechanism, positive contact alignment and strength to resist unbalanced stress and strain. Tanks are of heavy gage steel, elliptical in shape and heavily welded at ends and bottom. They are provided with lining of high dielectric material.

Quick-clearing, high-speed interruption is secured by an arcing contact structure which combines the advantages of magnetized arc zones, thermal absorption capacity and occluded contacts. Other features include oil and gas separators, shock absorbers, internal mechanism and individual solenoid per pole.

The new breaker is for cell structure, truck or platen mounting and is furnished for 2,000 amp. or less at 15,000 volts.

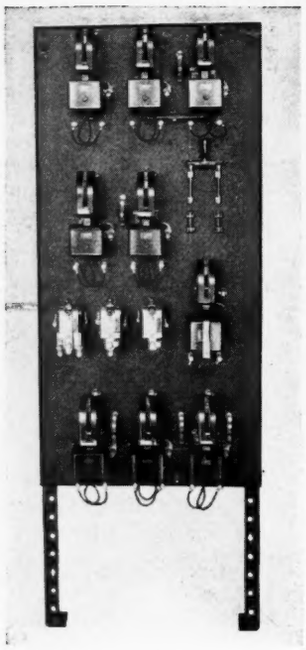


**Type F-114 circuit breaker**

## Actinized Bearing Bronze

HIGH-LEAD BRONZE in which by a special "Actinizing" process all internal strains, growth, and distortion are said to have been eliminated has been introduced by the Sumet Corporation, Buffalo, N. Y. The material is available in cored and solid bars, drawn rods, and in castings of all sizes, and can be had in soft, medium and hard grades.

The new metal is claimed to have a true homogeneous structure, with the lead particles embedded in the matrix, thus combining the anti-frictional qualities of babbitt with the tensile strength of bronze.



**Magnetic control panel for use with cranes**

## Crane and Hoist Control Improved

TWO TYPES of control are involved in a redesigned line of magnetic control panels for use with cranes announced by General Electric Company, Schenectady, N. Y. One, designated CR-4426, is for use on the bridge and trolley motions of cranes, and the other, designated CR-4422, is for application on hoist motions.

All of the advantageous features of the superseded lines of panels are included in the redesign, and a number of improvements have been incorporated. Each type is available in two forms, one with and one without overload protection. On both, the circuit breaker contactor, which formerly opened only an overload, has been replaced by a line contactor. This is in the opposite side of the line to the reversing contactors and opens each time the master switch is returned to the "off" position. This allows complete isolation of the motor and starting resistor from the sources of power when the master switch is moved to the "off" position.

A new type of three-point, cam-operated master switch is used and new overload relays are incorporated which allow a greater calibration range and require but one coil instead of two or three for a given contactor size. The new magnetic control is available either with or without shunts.

## Constant-Weight Feeder for Coal and Dry Materials

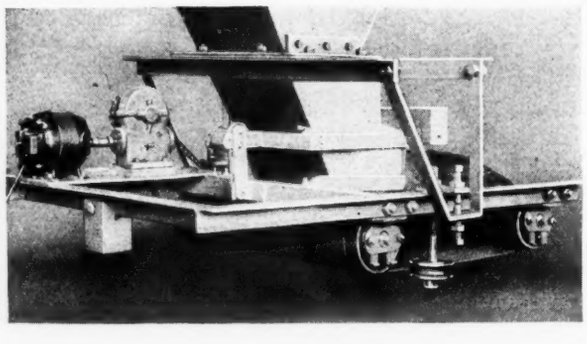
ABILITY to regulate both course and fine feeds by weight, and automatically maintain the weight constant regardless of changes in conditions due to bin segregation, nature of material or entrained moisture, characterizes the new constant-weight feeder for pulverizing mills, kilns, dryers and similar equipment recently brought out by the Hardinge Company, 122 East 42d St., New York City.

In this feeder, which is a self-contained unit, a short traveling belt attached to a frame, on which the driving mechanism is located, is suspended on two pivoted points so that any variation in the weight on the belt will move the frame either up or down, which, in turn, opens or closes the feed gate a sufficient amount to bring the weight back to that originally set. The quantity of feed is controlled by a balancing weight on a lever extended from the gate. By moving the weight along the lever any desired feed is obtained. A revolution counter is included as standard equipment.

To preclude the possibility of any change or irregularity in the feed weight through belt pull or other method of driving, the driving unit, consisting of a small motor and speed reducer, is mounted on the same frame as the traveling belt, the whole being suspended from the bottom of the overhead bunker or supply bin.

By a remote control device the feed may be varied from any point distant from the feeder itself. Synchronizing mechanism may also be employed to any two or more feeders at the same time, and a control attachment which will signal the operator or actuate a bin rapper can be supplied to stop the feeder when the material fails to flow.

If desired the feeder can be used as a proportioning device with two or more feeders delivering to a common point and controlled simultaneously. A number of sizes are available, ranging in capacities up to 120 tons of coal an hour.

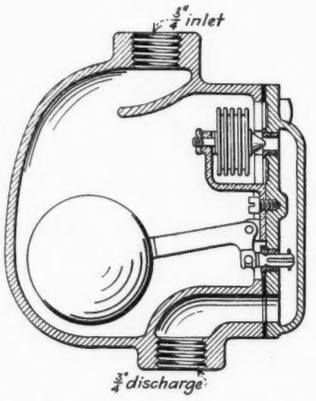


**Type D constant-weight feeder**

## Blast Trap for Unit Heaters

IN THE blast trap illustrated, which is designed especially for unit heaters of the smaller sizes and for draining hot blast coils, steam mains and similar apparatus, the air relief is handled by the thermostatic member mounted in the upper part of the body, and the water by the float-operated valve.

The valve, valve body, cover nut and link are of the best quality steam brass, the float is of seamless copper and the air valve thermostatic element is the standard multiflex bellows made by the trap manufacturer, the Bishop & Babcock Sales Company, 4910 Hamilton Ave. N. E. Cleveland, Ohio. Capacities of the trap range from 200 lb. an hour at ¼ lb. pressure to 800 lb. an hour at 5 lb. pressure.




**Section of combination thermostatic and Type D constant-w**

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A NEW gasket compound, known as Nacotex, introduced by the National Cork Products Company, 357 Ogden St., Newark, N. J., is said to have high heat-resisting powers, does not dry out, crumble or become spongy and is not affected by oil, gasoline, grease or water.

# NEWS of the FIELD

## *Spot News*

PRELIMINARY RUNS *are now being conducted at the Holland station of the General Gas & Electric Corporation prior to placing the first 55,000-kw. unit on the line in the near future. Operating at a steam pressure of 1,400 lb., the plant is designed for an ultimate capacity of 220,000 kilowatts.*

BILLS *covering recommendations of the committee on revision of the New York Public Service Commission law, as published in* POWER *of March 11, were introduced in the State Legislature last week. Most important were those establishing a valuation procedure, controlling holding companies, limiting mergers and creating a people's counsel.*

WORK *will start shortly on the erection of a dam and hydro-electric plant of 150,000-hp. capacity on New River near Hawk's Nest, W. Va., for the Kanawha Power Company, subsidiary of Union Carbide & Carbon Company of New York. Contract for the construction has been awarded to Rinehart & Dennis, Charlottesville, Va., and it is expected the plant will be completed in two years.*

AT THE ELECTION *held in Tacoma, Wash., March 11, voters refused to sanction the renewal of the Puget Sound Power & Light Company's franchise, which expires on June 21. The vote was 5,519 in favor of and 18,478 against allowing the company to sell power within the city limits.*

BY A VOTE *of 38 to 29, the Senate on March 19 rejected an amendment to the tariff bill proposing a duty of $1 a barrel on crude oil and 50 per cent ad valorem on refined products.*

## Many American Papers Submitted for World Power Conference

**Of particular interest are those on steam turbines, boiler corrosion, water-power storage plants, byproduct power and standardization**

AS PLANS for another World Power Conference take shape, technical papers on all branches of power engineering pour in on sectional committees throughout the world. The second plenary session of the conference, to be held in Berlin, Germany, next June 16-25, will find the United States represented with a well-rounded selection of outstanding treatises, according to latest reports of the American committee.

Discussion of subjects coming up at the conference will be divided into four classes. Sources of power will be in Class A; power production, transmission and storage will come under Class B; utilization of power will be in Class C; and general subjects closely akin to the power field will come under Class D. A large corps of American scientists and engineers has already prepared many papers in all four classes and will take an active part in the discussion sessions next June.

Of particular interest among the large number of papers already received by the American committee are those dealing with steam turbines, corrosion fatigue in boilers, research relating to power development, progress in the utilization of water-power storage plants, economic developments in turbine-generator design, byproduct power in industry, and the advancement of standardization. Following are a few of the American papers on these subjects:

RESEARCH RELATING TO POWER DEVELOPMENT, by C. F. Hirshfeld—A review of the part played by research in the development of power. The author considers the place of research not only in the technical advance of power generation and utilization, but also in the complicated and important business, economic and social problems involved.

RECENT AND POSSIBLE FUTURE DEVELOPMENTS AFFECTING THE ECONOMICS OF LARGE STEAM TURBINE PRACTICE IN THE UNITED STATES, by G. B. Warren—This paper deals with the general trend of large steam turbine design as it bears on the economics of power plant design in the United States. The four definite trends treated are increased unit capacity, increased output per square foot of last-stage bucket area, design and operation on more efficient heat cycles, and increased efficiency of the turbine-generator. Mr. Warren sees the art developing so rapidly that conditions in the near future may appear appreciably different.

ECONOMIC DEVELOPMENTS IN TURBINE-GENERATORS IN THE UNITED STATES, by M. A. Savage—A summary of the enormous increase in generator capacities, necessitated by the ever-growing economic demand for combining large power systems into still larger systems. The author tells how problems of design and operation arising from the increased size of units were met.

INTERCRYSTALLINE CRACKING IN STEAM BOILERS, by F. G. Straub—A discussion of the large losses sustained by industry through the occurence in boilers of intercrystalline or transcrystalline cracks. Means of preventing these cracks are briefly touched upon.

PROGRESS IN WATER-POWER STORAGE, by W. S. Lee—This paper deals with the advantages to large power systems of the efficient use of hydro-electric plants in combination with steam power. Particular emphasis is laid on utilization of variable-flow streams.

POWER PRODUCTION IN THE STEEL INDUSTRY, by W. E. Clarke—Treatment is here given on the selection of a proper system and equipment for providing power services to meet modern conditions in the steel industry. The author considers in detail the use of byproducts of the blast furnace for power generation.

THE VALUE OF STANDARDS FOR POWER ECONOMY IN TECHNICAL RESPECTS, by L. L. Elden—A review of savings effected through standardization in the power field and closely related fields during the past few years. Mr. Elden also shows how the use of standards has contributed enormously to the economic progress of the United States.

GOVERNMENT INTEREST IN THE ADVANCEMENT OF STANDARDIZATION, by R. M. Hudson—The large part played by the United States government in promotion of standardization is set forth in this paper. The author shows how the Department of Commerce in close touch with engineering societies has developed and encouraged the adoption of money-saving standards.

## TRENTON CHANNEL NOW COMPLETE

*With the recent starting of the fifth 4,000-kw. direct-current auxiliary unit and the completion of remodeling work on boilers 7, 8 and 9, Trenton Channel Station of the Detroit Edison Company reached its originally planned ultimate capacity of 300,000 kw. The installation consists of six 50,000-kw. turbine-generators supplied by steam from thirteen pulverized-fuel-fired boilers.*

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# Washington News

**Week's progress of Power and Trade Commission hearings, Muscle Shoals lobby and Boulder Dam activities**

FOREMOST among recent events in the power field is the introduction by Senator Couzens of a bill extending the Federal Power Commission to include wide control over the sale and financing of interstate power. Not only does the proposed legislation create an independent commission (five members at $12,000 per year), but it also gives this new body authority to extract information and, in the final analysis, to fix the rates of producers and distributors across state lines. Beyond that, it grants power over the management and holding companies, which, it is claimed, are out of reach of existing state agencies. Senator Couzens claims, however, that existing rights of state regulatory bodies will not be diminished, but rather enhanced. Extensive hearings on the bill are to be held. That interstate power is a larger factor in the utilities business than shown by the N.E.L.A. figure of 10.9 per cent for 1928 is indicated by preliminary results for 1929 as compiled by the Federal Trade Commission from questionnaire returns.

EXAMINATION of the American Gas & Electric Company, the first holding group to come under the utilities investigation, was completed at the Trade Commission last week. Though certain practices, especially the "writing up" of values in the process of adding properties to the group, were subject to intensive questioning, the company officials held that all their dealings have been upheld in principle by existing law and past court decisions. Some weeks probably will elapse before the next company is called to testify.

ATTEMPTS to influence Muscle Shoals legislation still are before the Senate Lobby Committee, with Claudius H. Huston, Republican National Chairman, a vigorous witness. Mr. Huston is being questioned as to his part in the financing and direction of the Tennessee River Improvement Association, a local organization which has supported the Cyanamid offer in the hope of building up a large electric-chemical industry about the Shoals properties. The Water Power Policies Committee of the United States Chamber of Commerce has issued a factual study of the Shoals situation. Recommendations are expected to follow early in April.

Nothing is actively stirring on Boulder Dam, although political rumblings in the West indicate that Arizona may still attempt to block the project by injunction proceedings unless given a settlement more favorable to her demends than so far offered. Gov. J. C. Phillips has said as much in a recent speech. Meanwhile, the Interior Department is said to have issued contract forms for the sale of power which await agreement by the contracting parties.

## Newark Station of P.G.&E. Co. to Be Largest on Coast

With the laying of spur tracks into the Newark sub-station of the Pacific Gas & Electric Company, work has been started on additions to plant which call for an expenditure of more than $2,000,000 and will treble the present capacity. The additions to the station are specifically designed to receive power developed on the company's Mokelumne River hydro-electric development, which is now in the course of construction in Amador County. Energy will be introduced into the Newark station over a 220-kv. transmission line.

The additional installation will consist of seven 24,000-hp. transformers and two 33,000-hp. synchronous condensers. One of the outstanding electrical engineering features of the substation will be the installation of a 60,000-volt underground cable, the first of this voltage to be used on the company's system.

When completed, the Newark substation will have the largest concentrated power supply on the Coast, according to the company's announcement. It will have six separate sources of hydro-electric power from which to draw energy. In addition, steam-electric power may be fed into the station from the recently completed steam plant at First and Grove Sts., Oakland, with a capacity of 82,500 hp.

The steam-electric generating plant at San Francisco, which is now undergoing extensive enlargement, ultimately having an installed capacity of 225,000 kw., will also supply energy into this distribution center.

## German Stations Testing Peat as Fuel

The increasing importance of Germany's lignite deposits for the production of power for municipal and industrial consumption is reflected in the expansion of the great electricity works. The biggest of the private works, the Rhenish-Westphalian Electricity Works, built for pit coal consumption, has an installation of 1,000,000 kw. The Elektrowerke A.G., the largest using lignite, has increased its capacity now to 730,000 kw. There is also a Prussian State works, the Preussische Elektro A.G., which has merged with the Sachsische Werke and the Bayern-Werke to form the A.G. fur Deutsche Elektrizitatswirtschaft, a holding company for the associated concerns.

The production of the Elektrowerke increased 15 per cent in 1929 to 2,300,000,000 kw., against two milliards for the Rhenish-Westphalian works. The consumption of lignite from the concern's own mines in Central Germany reached 4,800,000 tons. Among its chief customers is the municipality of Berlin.

Experiments are being undertaken in Germany with every hope of success in making use of peat for the electrical

industry. Peat briquettes have been experimentally made and the peat coked, with results described as equalling those obtained from lignite. Should these hopes prove justified, a province so remote from coal supplies as East Prussia would be made independent of coal by its wide expanses of moorland. It remains to be seen whether the processes will be commercially successful; if they prove so, the influence on industry may be revolutionary. Such a development would be the salvation of East Prussia, which is being very severely hit indeed, agriculturally, industrially and commercially, by its isolation through the Polish corridor.

## Buhl Denied Right to Buy Plant on Revenues

The right of the city of Buhl, Idaho, to contract with Fairbanks, Morse & Company for the purchase of a Deisel electric generating plant for $96,984 paying therefor by monthly pledge orders to be liquidated from the revenues of the plant, has been denied by the Idaho Supreme court.

The main question before the court was whether the city, by entering into such a contract payable solely out of the possible revenues of the plant, would have violated a certain article of the constitution of the state of Idaho placing limitations on county and municipal indebtedness. This clause of the constitution prohibits any subdivision of the state from incurring indebtedness or liability in that year exceeding the income and revenue provided for it for such year without the assent of two-thirds of the qualified electors, or unless provision be made for the collection of an annual tax sufficient to pay the interest on such indebtedness and provide a sinking fund for the payment of the principal in twenty years. The suit was brought by Grant Miller, a taxpayer, with the Idaho Power Company and a number of other taxpayers as intervenors.

In its decision the court referred to the case of Feil vs. city of Coeur d'Alene, Idaho (129 Pac. 643).

## Hawley and Barstow Firms Erecting Manila Plant

Contrary to the report in last week's issue of *Power*, design and construction work on the new 30,000-hp. hydro-electric plant now being erected near Manila, P. I., is being handled by the Charles B. Hawley Engineering Corporation of Washington, D. C., and W. S. Barstow & Company, with headquarters at Reading, Pa. The Hawley corporation has charge of all hydraulic engineering and power house design, while all construction is in charge of the Barstow company. When completed, this plant will furnish power to the Manila Electric Company, which is a part of the Associated Gas & Electric Company's system.

## Col. Peter Junkersfeld Dies Suddenly

Colonel Peter Junkersfeld, vice-president of Stone & Webster Engineering Corporation, died suddenly on the night of March 18 at his home in Scarsdale, N. Y. He was 61 years old and had been in his office the day of his death.

Colonel Junkersfeld was born in Sadorus, Ill., was graduated from the University of Illinois in 1895, and soon after entered the employ of the Commonwealth Edison Company, where he remained for 24 years. In 1916 Mr.

*Blank & Stoller, Inc.*

**Col. Peter Junkersfeld**

Junkersfeld was elected president of the Association of Edison Illuminating Companies. He resigned from the Commonwealth Edison Company in 1919 to become associated with Stone & Webster in New York. He resigned from this position in 1922 to become a member of McClellan & Junkersfeld, Inc., engineers and constructors. In 1928, his firm was merged with the division of construction and engineering of Stone & Webster and Colonel Junkersfeld became a vice-president of the organization.

Early in the war, Josephus Daniels, then Secretary of the Navy, appointed Mr. Junkersfeld to the Naval Consulting Board as an associate member, and he was actively engaged in building cantonments, camps, hospitals, port terminals, warehouses, and munition plants. Later he joined the army, with the rank of colonel and in 1919 was awarded the Distinguished Service Medal.

Colonel Junkersfeld was a past president of the American Institute of Electrical Engineers, was the first president of the Construction Division Association, a past vice-president of the Western Society of Engineers, and a member of the A.S.M.E.

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THREE 1,760-hp., 8-cylinder Diesel engines were ordered recently by the Otter Tail Power Company from the Nordberg Manufacturing Company, of Milwaukee, Wis. Two of these engines will be installed in the company's plant at Appleton, Minn., and the third is to go in the Langdon, N. D., plant.

# News of Canada

**Freeman outlines power possibilities of B. C. coal deposits—50,000-hp. plant for Spicer Rapid**

POWER possibilities of the great coal deposits of British Columbia were recently presented in a startling way by H. N. Freeman, of Vancouver, B. C., a well-known coal expert, in an address to the British Columbia Chamber of Mines.

Pulverized coal, utilizing the products of the cheapest kind from the mines, a material now comparatively valueless, can compete with all but the most favorable water powers in the production of electrical energy, Mr. Freeman declared.

British Columbia has coal fields so large in extent, and so conveniently scattered about the province, that they could be used to electrify every mile of railway in the province, and at the same time provide power for all present and future industrial plants, he said.

Starting with the Peace River, Mr. Freeman declared that known coal areas there would supply power to operate the proposed coast railway outlet. The Portland Canal and Bear River districts have sufficient coal to operate all railways ever to be built in that country. The coal fields at Telkwa would provide current to operate the Canadian National line from Prince George to Prince Rupert.

In the center of British Columbia, the fields at Merritt and Princeton would provide energy for operation of the coast sections of both the Canadian Pacific Railroad and the Canadian National, as well as the Kettle Valley Railway. The Crow's Nest Pass mines would supply all lines in that area, while Vancouver Island has virtually inexhaustible coal deposits.

Utilization of pulverized coal, Mr. Freeman said, was improving steadily, and he predicted that, apart from its possibilities in the production of electrical energy, it will soon be used almost exclusively for direct firing, both in industry and for domestic purposes. If properly applied it would soon lessen the importation of fuel oil, which has worked havoc in the British Columbia coal industry in recent years, Mr. Freeman concluded.

APPLICATION has been made by the Southern Canada Power Company to the Quebec Public Service Commission for permission to construct a $6,000,000 hydro-electric development on the St. Francis River, about six miles northwest of Drummondville, Quebec. The development would take place at Spicer Rapid, where the proposed plant would contribute to the ultimate production of 50,000 hp. Plans submitted to the commission show that four 12,000-hp. units would be scheduled to go into commission as the demand for power dictated. Construction work will start as soon as permission is granted.

## Equipment for Diablo Plant Ordered by Seattle

Contract for furnishing machinery for the City of Seattle's Diablo hydro-electric plant on the Skagit project has been awarded to the Westinghouse Electric & Supply Company. The equipment to be furnished includes two 66,700-kva. generators at 90 per cent power factor, including water cooling system and spare parts, $719,400; one spare exciter and spare parts $6,320; two 1,500-kva. auxiliary generators and spare parts, $32,375; seven main transformers, 20,000 kva., 165,000/13,200 volt, increased 15 per cent capacity at an additional cost of 2 per cent, $260,406. The Moloney Electric Company was awarded contract for furnishing three 1,000 kva. transformers at $3,286 each.

Contract for furnishing two waterwheels, with a rated capacity of 91,000 hp., and a maximum of 95,000 hp. was awarded to the S. Morgan Smith Company for $648,550. This contract brings the total investment at this Diablo unit up to $1,500,000. Contract for two butterfly valves yet to be awarded will add, it is stated, about $100,000 to the investment.

# Obituary

NATHANIEL C. ROBBINS, New York advertising sales representative of *Power*, died on Sunday afternoon, March 16, at his home in Nyack, N. Y., after an illness of nearly three months. He was 57 years old.

Born at Nyack, Mr. Robbins received his early education there and was graduated from Cornell University in 1894. He served in the Spanish-American war with the Astor Battery of the field artillery. After the war he entered the printing and engraving business, where in 1900 he became associated with John A. Hill, publisher of *Power* at that time. He served the Hill Publishing Company and its successor, the McGraw-Hill Publishing Company, in the capacity of printing salesman and later New York representative of *Power* until his death.

Mr. Robbins was a member of the Machinery Club, Cornell Club and the Sons of the American Revolution.

WILLIAM J. LONGMORE, consulting purchasing agent for Westinghouse Electric & Manufacturing Company, succumbed to pneumonia, March 4, at his home in Bellevue, Pa. He had been connected with the Westinghouse company since 1886 and had been identified with the purchasing department during the past fifty years. He was perhaps the longest in continuous service of any man in the employ of the company.

Mr. Longmore was born in old Allegheny, now Pittsburgh, and moved to Bellevue when a boy.

# COMING CONVENTIONS

**American Society of Mechanical Engineers.** Fiftieth Anniversary Celebration at New York City, Hoboken, N. J., and Washington, D. C., April 5-9, 1930. Semi-Annual meeting at the Hotel Book-Cadillac, Detroit, Mich., June 9-12, 1930. Secretary, Calvin Rice, 33 West 39th St., New York City.

**American Institute of Electrical Engineers,** District meeting at Springfield, Mass., May 7-10. Annual summer convention at Toronto, Canada, June 23-27. Secretary, F. L. Hutchinson, 33 West 39th St., New York City.

**American Society of Heating & Ventilating Engineers.** Annual summer meeting at the Curtis Hotel, Minneapolis, Minn., June 23-25. Secretary, A. V. Hutchinson, 33 West 39th St., New York City.

**American Society of Refrigerating Engineers.** Annual spring meeting at the Atlanta Biltmore Hotel, Atlanta, Ga., May 7-9. Secretary, David L. Fiske, 37 West 39th St., New York City.

**American Society for Testing Materials.** Annual meeting at Haddon Hall, Atlantic City, N. J., June 23-27. Secretary, C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

**American Welding Society.** Annual meeting at society headquarters in New York City, April 22-25. Secretary, M. M. Kelly, 33 West 39th St., New York City.

**Association of Iron and Steel Electrical Engineers.** Annual convention and iron and steel exposition at Broadway Auditorium, Buffalo, N. Y., June 16-20. Managing director, John F. Kelly, Empire Building, Pittsburgh, Pa.

**Canadian Electrical Association.** Annual Convention at the Manoir Richelieu via the S.S. "St. Lawrence," June 11-13, 1930. Secretary, H. M. Lyster, 405 Power Building, Montreal, Quebec.

**International Congress for General Mechanics** at Liege, Belgium, Aug. 31 to Sept. 7, 1930. For information address Alb. Schlag, 4 Place Saint-Lambert, Liege, Belgium.

**International Railway Fuel Association.** Annual meeting at the Hotel Sherman, Chicago, Ill., May 6-9. Secretary, C. T. Winkless, Room 700, LaSalle St., Station, Chicago, Ill.

**National Electric Light Association.** Annual convention at Municipal Auditorium, San Francisco, Calif., June 16-20, 1930. Secretary, A. J. Marshall, 420 Lexington Ave., New York City.

**National Oil and Gas Power Meeting,** under auspices of A.S.M.E. Oil and Gas Power Division and Pennsylvania State College, will be held at State College, Pa., June 12-14. Chairman, L. H. Morrison, c/o *Power*, 10th Ave. and 36th St., New York City.

**National Power Show.** Held in connection with the International Textile Exposition at Mechanics Building, Boston, Mass., April 28 to May 3. For information, write to the New England Association of Commercial Engineers, 53 Devonshire St., Boston, Mass.

**Second Plenary World Power Conference.** Convenes at Berlin, German, June 16-25. Chairman of the American Committee, O. C. Merrill, Edmunds Building, Washington, D. C.

# Personals

CLARENCE E. DARLING, formerly of the staff of the American Society of Mechanical Engineers, and JOHN W. MCNAIR, of the standards department of the American Institute of Electrical Engineers, have been appointed to the staff of the American Standards Association, as a part of the program to extend the national industrial standardization activities of the A.S.A., which was made possible by recent refinancing of the organization that made $500,000 available for this work.

H. G. THIELSCHER, of Stone & Webster, Inc., Boston, Mass., is acting as consulting engineer for the San Joaquin Light & Power Corporation, Fresno, Calif., in connection with the design of its 35,000-kw. steam plant now under construction.

C. H. BRANDES, formerly chief mechanical engineer and general purchasing agent of the American Metal Company, Ltd., and subsequently vice-president of the Metallurgical & Chemical Corporation and the International Process & Engineering Corporation, has joined the Western Precipitation Company of Los Angeles and New York. He will make his headquarters at the New York office.

GEORGE G. RADCLIFF, of Sacramento, Calif., has been named vice-president of the American River Hydro-Electric Company and general manager of its Sacramento interests, according to an announcement of J. W. Mason, president of the company. The company's particular aim is to negotiate a contract with the state for the construction of a dam for flood control and the generation of hydro-electric power on the American River at Folsom, in accordance with an act of the 1920 legislature.

WILLIAM P. CREAGER, chief engineer of the Power Corporation of New York and vice-president of the Northern New York Utilities, Inc., sailed from New York March 8 en route for Russia, where he will act as consulting engineer for the Soviet government of Russia on its $50,000,000 hydro-electric development and navigation project. Mr. Creager will represent the J. G. White Engineering Corporation of New York, with which he was associated for seventeen years before becoming identified with the up-state properties. He is considered an authority on hydro-electric development and has written several books on the subject. He will be away about two months.

S. P. MACFADDEN, formerly vice-president and general manager of the Western Public Service Company, Scottsbluff, Neb., has just been named assistant to the president of the Engineers Public Service Company with headquarters in Boston. Both these properties are under the executive management of Stone & Webster.

# Business Notes

HENDRICK MANUFACTURING COMPANY, Carbondale, Pa., announces the removal of its Pittsburgh, Pa., office from the Union Trust Building to the Koppers Building.

THE JAMES LEFFEL & COMPANY, Springfield, Ohio, announces the removal of their Minneapolis, Minn., office to Room 444, 20 North Wacker Drive, Chicago, Ill.

PEABODY ENGINEERING CORPORATION, New York City, on or about April 15 will move from its present offices at 110 East 42nd. St., to the entire 39th floor of the Lefcourt Colonial Building at Madison Ave. and 41st Street.

WAGNER ELECTRIC CORPORATION, St. Louis, Mo., announces the transfer of P. Loyd Lewis from the managership of the Kansas City branch office to the home sales office, where he has been placed in charge of the merchandising division.

GENERAL ELECTRIC COMPANY, Schenectady, N. Y., announces that out of its 70,000 employees, 37 who during 1929 saved money for the company or contributed to its efficiency in an unusual degree have been given awards under the Charles A. Coffin Foundation. The awards in each case consist of a certificate of merit and a substantial sum of money. Twenty-four of the recipients are factory workmen or foremen, and their suggestions effected a definite annual saving for the company. In nine cases these savings are estimated to total more than $1,250,000 a year.

STONE & WEBSTER, INC., Boston, Mass., and subsidiaries report for the six months ended Dec. 31, 1929, the first six months in which the company operated, a total profit of $4,079,648, or $3.24 a share on 1,258,981 no par shares of stock.

A. O. SMITH CORPORATION, Milwaukee, Wis., reports for the six months ended Jan. 31 a net profit of $2,674,811 as compared with $913,334 in the corresponding period of the preceding year.

MASON REGULATOR COMPANY, Boston, Mass., announces the appointment of King & Shepard, 50 Church St., New York City, as distributors of its products for the Manhattan district.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, East Pittsburgh, Pa., reports that sales billed, orders booked and net income during 1929 exceeded those for any previous year in the company's history. For the year ended Dec. 31, 1929, sales billed amounted to $216,364,588 against $189,050,302 during 1928, and net income totaled $27,062,611 as compared with $20,814,940 for the previous year.

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# *With the* SOCIETY SECTIONS

**A.S.M.E., Metropolitan Section.** Power division meeting in Room 501, Engineering Societies Building, on March 25 at 8 p.m. Subject: "Progress in the Use of High-Pressure Steam," by J. B. Crane, high-pressure specialist of the Combustion Engineering Corporation, New York City. Meeting sponsored by the Fuels Division of the A.S.M.E. on April 3 at 8 p.m.

**A.S.M.E., Plainfield Section.** Joint meeting with the Plainfield Engineers Club at Masonic Temple, Elizabeth, N. J., on April 3. Subjects: "Some Aspects of the Petroleum Industry of Interest to Mechanical Engineers," by R. T. Haslem, vice-president of the Standard Oil Development Company, and "Stresses in Thick Tubes Subjected to High Pressures and Temperatures," by E. W. Luster, assistant manager of the General Engineering department of the Standard Oil Development Company.

**A.I.E.E., Niagara Frontier Section.** Meeting at Niagara Falls Power House No. 2 on April 18. Subject: "Use of Regulators in Industry," by J. H. Ashbaugh, regulator engineer of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

**Midwest Bituminous Coal Conference.** Held under the direction of the Engineering Schools of Purdue University, Coal Trade Association of Indiana and Illinois Coal Bureau, at Lafayette, Ind., April 9-11. Chairman, W. A. Knapp, Purdue University, Lafayette, Ind.

**New England States Association of the National Association of Power Engineers.** Annual convention and exhibition of power machinery at the State Armory, Salem, Mass., June 19-20, 1930. Secretary, E. S. Daniels, 113½ Bridge St., Salem, Mass.

**Northwest Electric Light & Power Association.** Engineering section; seventh annual meeting at the Hotel Morck, Aberdeen, Wash., March 26-28. Secretary, B. H. Snow, 1206 Spalding Bldg., Portland, Ore.

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# Trade Catalogs

CRANES—A complete description of the Whiting Tiger Crane is given in Bulletin 188 issued by the Whiting Corporation, Harvey, Ill. Contained in its 24 pages are many illustrations, some of which are in color, of constructional details and installations. Another recent folder of the company describes and illustrates a completely automatic stoker for all boilers from 250 to 2,500 sq.ft. of heating surface.

INSTRUMENTS—"Investments for Immediate Profits" is the title of an attractively illustrated booklet just issued by the Consolidated Ashcroft Hancock Company, Bridgeport, Conn., which shows the valuable records and savings obtainable through the proper use of recording and indicating instruments in the power plant.

WATER TREATMENT—Advantages and applications of the zeolite water-softening system are presented in a straightforward manner for engineers and executives in Bulletin No. 120, entitled "The Economy of Soft Water," published by the Elgin Softener Corporation, Elgin, Ill. Printed in color, this 16-page booklet contains many illustrations of Elgin installations.

PUMPS—Three interesting booklets on pumps have been published recently by the Blackmer Pump Company, Grand Rapids, Mich. They are: "The Secret of Hydraulic Balance," a valuable treatise on economical pump operation; "Blackmer Rotary Pumps" and "Blackmer Centrifugal Pumps," containing engineering data on these types of pumps.

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# Fuel Prices

## COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except Pittsburgh gas slack:

| Bituminous (Net Tons) | Market Quoting | Price per Ton |
|---|---|---|
| Navy Standard | New York | 2.20 @ 2.30 |
| Kanawha | Columbus | 1.35 @ 1.50 |
| Smokeless | Cincinnati | 1.75 @ 2.25 |
| Smokeless | Chicago | 1.75 @ 2.25 |
| S. E. Kentucky | Chicago | 1.40 @ 1.60 |
| Steam | Pittsburgh | 1.40 @ 1.65 |
| Gas Slack | Pittsburgh | .90 @ 1.10 |
| Big Seam | Birmingham | 1.35 @ 1.50 |
| **Anthracite** (Gross Tons) | | |
| Buckwheat | New York | $2.70 @ 3.00 |
| Barley | New York | 1.40 @ 1.50 |

## FUEL OIL

**New York**—Mar. 20, f.o.b. Bayonne, N. J., 28@34 deg., Baumé, industrial use, tank-car lots, 4.75@5.5c. per gal.; f.o.b. Bayway, 36@40 deg., furnace, tank-car lots, 6c. per gal.

**St. Louis**—Mar. 14, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.520 per bbl., or 42 gal.; 26@28 deg., $1.570 per bbl.; 28@30 deg., $1.620 per bbl.; 30@32 deg., $1.670 per bbl.; 32@36 deg., gas oil, 4.276c. per gal.; 37@40 deg., distillate, 4.98c. per gal.

**Pittsburgh**—Mar. 18, f.o.b. local refinery, 30@34 deg., fuel oil, 4.5@4.75c. per gal.; 36@40 deg., 4.75c.

**Philadelphia**—Mar. 11, 13@19 deg., $1.05@$1.10 per bbl. or 42 gal.; 22 deg. plus, $1.575@$1.625 per bbl.; 23@27 deg., $2.10@$2.15 per bbl.

**Cincinnati**—Mar. 11, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5.25c. per gal.; 26@30 deg., 5.5c. per gal.; 30@32 deg., 5.75c. per gal.

**Chicago**—Mar. 14, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl. or 42 gal.; 22@26 deg., 85@90c. per bbl.; 26@30 deg., $1.05@$1.10 per bbl.; 30@32 deg., $1.20@$1.25 per bbl.

**Boston**—Mar. 17, tank-car lots, f.o.b., 12@14 deg., Baumé, 3.2c. per gal.; 28@32 deg., 5c. per gal.

**Dallas**—Mar. 15, f.o.b. local refinery 26@30 deg., $1.25 per bbl. or 42 gallons.

# New Plant Construction

COMPILED BY THE MCGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

**Conn., New London** — Lawrence Memorial Hospital, Ocean Ave., awarded contract for the construction of a central heating plant to H. Wales Lines Co., 134 State St., Meriden. Estimated cost $75,000.

**Ill., Chicago**—Commonwealth Edison Co., 72 West Adams St., awarded contract for addition to electric service station at 22nd and Throop Sts. to E. Scheidenhelm Co., 333 North Michigan Ave., also soon award contract for a 2 and 7 story, 254 x 330 ft. electric service station at California Ave. and Addison St. Estimated cost $700,000 and $1,000,000 respectively.

**Ill., Quincy**—Lincoln Douglas Hotel Co., C. H. Davis, Pres., c/o Abraham Lincoln Hotel, Springfield, will soon award contract for the construction of an 8 story hotel and stores building including steam heating, ventilation and refrigeration systems, etc. at 4th and Main Sts., here. Estimated cost $500,000. C. W. Nichol, 310 South Michigan Ave., is architect.

**Ind., Evansville**—Weil Packing Co., received lowest bids for the construction of a packing plant including beef cooling rooms, cold storage plant, etc. from C. Kanzler & Son. Estimated cost $50,000.

**Ia., Sioux City**—Blackstone Realty Co., c/o A. Sanford, Francis Bldg., awarded contract for the construction of a 10 story hotel at Sixth and Nebraska Sts. to W. A. Klinger Inc., Warnock Bldg. Estimated cost $1,250,000. Steam heating system, etc. will be installed. Eppley Hotels Co., 1804 Dodge St., Omaha, Neb., lessee.

**Kan., Manhattan** — United Light & Power Corp., Abilene, will soon receive bids for the construction of a 5 story, 84 x 112 ft. power plant, here. H. B. Winter, Ulrich Bldg., is engineer.

**Kan., Wichita**—Allis Hotel Co., A. R. Brasted, Secy., awarded general contract for an 18 story hotel at Lawrence and Williams Sts. to G. H. Siedhoff Construction Co., Broadview Hotel Bldg. Estimated cost $1,500,000. Steam heating, plumbing and ventilation awarded.

**Kan., Wichita**—Kansas Gas & Electric Co., c/o J. H. LaGrant, Purch. Agt., 205A Sedgwick Bldg., will receive bids until Apr. 1 for the construction of a 1 story service building. C. V. Waddington c/o owner, is architect.

**Mass., Boston**—Edison Electric Illuminating Co., 39 Boylston St., is receiving bids for the construction of a power station, $40,000, also alterations to power stations at Scotia St. and L St.

**Mass., Boston** — Transit Dept., will receive bids until Mar. 31, for the construction of a power station at Massachusetts Station and Boylston St. subway. Estimated cost $50,000. Private plans.

**Mass., Ipswich**—Town, A. W. Walton, Town Hall, plans addition to electric light plant. Estimated cost $40,000. Private plans.

**Mass., Lynn**—Police Dept., D. Dinneen, City Hall, will soon receive bids for the construction of a police station, garage and boiler house. Estimated cost $150,000. Private plans.

**Mich., Detroit**—Grace Hospital, John R. St., awarded contract for the construction of a 6 story nurses' home at Alexandrine Ave. to Otto Misch Co., 159 East Columbia St. Estimated cost $600,000. Steam heating, ventilation and refrigeration systems, boilers, elevators, etc., will be installed.

**Minn., Minneapolis**—William Bros. Boiler & Mfg. Co., Nicollet Island, plans the construction of a power plant including equipment at East Hennepin Ave. and 10th Ave. S. E. Estimated cost $100,000. Engineer not announced.

**Mo., Concordia**—City plans an election Apr. 8 to vote $30,000 bonds for the construction of a municipal electric light plant. W. B. Rollins & Co., 339 Railway Exchange Bldg., Kansas City, are engineers.

**N. J., Newark**—Public Service Electric & Gas Co., 80 Park Pl., awarded contract for the construction of 50 x 56 ft. electric sub-station at 439-467 Passaic Ave. to Public Service Production Co., 80 Park Pl. Estimated cost $40,000.

**N. J., Newark**—St. Barnabas Hospital, 685 High St., plans the construction of a hospital, nurses home, power plant, etc. Estimated cost $1,500,000. Crow, Lewis & Wick, 200 5th Ave., New York, N. Y., are architects. Maturity in October.

**N. Y., Long Island**—Dept. of Public Works, F. S. Greene, Supt., Albany, awarded contract for the construction of three buildings, power house and service tunnels at Pilgrim State Hospital, Pine Aire Station here, to M. Shapiro & Sons, 1560 Broadway, New York, $1,788,500.

**Pa., Grove City**—Cooper Bessemer Corp., 150 Lincoln Ave., awarded contract for the construction of a 50 x 70 ft. power plant on Lincoln St. to W. J. Camlin, Newark, O. Estimated cost $160,000. Owner builds and installs equipment.

**Pa., Martins Creek**—Alpha Portland Cement Co., Hamilton St., Easton, awarded contract for turbine generator for steam power unit for utilization of waste heat to Westinghouse Electric & Mfg. Co., 150 Broadway, New York. Estimated cost $40,000.

**Pa., Pittsburgh** — U. S. Engineers Office, awarded contract for the construction of a hydro-electric plant for Lock No. 7 on Allegheny River to James Leffel & Co., Springfield, O.

**Tenn., Nashville**—City plans an election June 26 to vote $100,000 bonds for addition to power plant.

**Tex., Galveston** — Treasury Dept., Office of J. A. Wetmore, Acting Supervising Archt., Washington, D. C., will receive bids until May 2, for the construction of a marine hospital including heating and refrigeration plants, laundry plant, electric elevators, etc., here. Estimated cost $750,000.

**Tex., Kerrville** — City, R. B. Ellis, Mgr., received lowest bid for the construction of a sewage plant including pumping station, from Wilson & Seward, $44,300.

**West Virginia**—Union Carbide & Carbon Co., 30 East 42nd St., New York, N. Y., awarded contract for the construction of a power dam to generate 150,000 hp. on the New River near Hawks Nest, also tunnel to extend through Gauley mountain from Gauley to Hawk's Nest, to Rinehart & Dennis, Charlottesville. Estimated cost $4,500,000.

**Wis., Port Washington**—Milwaukee Electric Railway & Light Co., 217 Michigan St., Milwaukee, plans the construction of a new steam electric plant, initial capacity 75,000 kw. here.

**Wis., Sheboygan**—Wisconsin Power & Light Co., 900 Gay Bldg., Madison, awarded contract for the construction of a steam electric generating station, 30,000 kw. initial capacity with provision for second unit 30,000 kw. here, to L. E. Myers Construction Co., 53 West Jackson Blvd., Chicago, Ill. Estimated cost $6,000,000. It will also be possible to further expand the plant at a future date by addition of a third unit, probably 60,000 kw. capacity. Estimated total cost approximately $25,000,000. Order for steam turbine and generating unit has been placed with Allis-Chalmers Co., West Allis St., Milwaukee.

**Ont., Galt**—I. S. Webster, plans the construction of an artificial ice plant.

## Equipment Wanted

**Hydraulic Hoists, etc. — Oregon** — Bureau of Reclamation, Denver, Colo., will receive bids until Apr. 25 for high-pressure gates with hydraulic hoists, conduit linings, conduit lining-transitions, circular conduit linings, elbows, and bolts for the sluice, irrigation and power outlets at Owyhee Dam, Owyhee project here.

**Motors and Boilers — Montreal, Que.** — C. Duranceau, 5847 Hamilton St., plans to purchase ten 60 hp. electric motors and two 25 hp. steam boilers.

**Pump—Winnipeg, Man.**—Public Utilities Committee, plans to purchase a steam driven boiler feed pump. $5,000.

**Pump and Motor—Gordon, Neb.**—City, A. Dam, Clk., will receive bids until Apr. 3, for a deep well turbine pump, etc. for proposed waterworks improvements. Estimated cost $19,500.

**Pump, etc.—Cyril, Okla.**—City, R. M. Means, Clk., will receive bids until Mar. 31, for a turbine well pump, etc. for proposed waterworks improvements.

**Pump—Robert Lee, Tex.**—City plans to purchase pump, etc. for proposed waterworks system and dam. Estimated cost $30,000.

**Pumping Equipment—Andover, Mass.**—Bd. of Selectmen, plans to purchase new steam pumping equipment for proposed addition and alterations to pumping station at Haggetts Pond. Estimated cost $40,000.

**Pumping Unit—Fabens, Tex.**—City plans to purchase pumping unit, etc. for proposed waterworks system. Estimated cost $60,000.

**Pumping Units, Switchboard, etc.—Columbus, O.**—Dept. of Water, will receive bids until Apr. 8 for two electro-centrifugal pumping units, switchboard, etc. for proposed booster pumping station.

**Pumps — Ingersoll, Ont.** — Town will soon receive bids for purchase and installation of deep well pumps for proposed waterworks improvements.

**Pumps, Engine, etc. — New Orleans, La.** — Sewage & Water Board, G. G. Earl, Gen. Supt., will receive bids until Apr. 30, for pumps for station "D" and 700 to 800 kw. Diesel engine driven unit for station "C" for proposed sewage system.

## Industrial Projects

**Calif., Los Angeles**—Calloidal Graphite Co., 812 Foreman Bldg., plans the construction of a 3 story factory. Estimated cost $60,000.

**Ill., Rockford**—Woodward Governor Co., W. T. Woodward, Secy. and Treas., is having preliminary plans prepared for a 2 story, 70 x 160 ft. addition to factory on Mills St. Estimated cost $60,000. F. A. Carpenter, Brown Bldg., is architect.

**Ind., Indianapolis**—Mid-West Corp., received lowest bid for the construction of plant and machine shop at Pratt and Capitol Ave. from G. Jadrian, Norwood Rd. Estimated cost $43,000. Bishop, Knowlton & Carson, 312 North Meridian St., are architects.

**Ind., Terre Haute**—American Can Co., 230 Park Ave., New York, N. Y., plans addition to plant here, also plans addition to plant at Chicago, Ill. Maturity about July 1. Estimated cost $250,000 and $2,000,000 respectively.

**N. J., Newark**—National Lock Washer Co., 40 Hermon St., awarded contract for the construction of a 4 story, 30 x 50 ft. addition to factory at Pennington and Hammond Sts., to Shore Construction Co., 95 Christie St. Estimated cost $50,000.

**N. J., Trenton**—J. A. Roebling & Sons Co., wire manufacturers, awarded contract for the construction of a 220 x 320 ft. wire mill to J. W. Ferguson, 152 Market St., Paterson. Estimated cost $300,000.

**O., Cleveland**—The Kroehler Mfg. Co., J. O. Taylor, Constr. Mgr., Fisher Bldg., Chicago, Ill., manufacturers of furniture, awarded contract for a 3 story, 79 x 200 ft. addition to factory at East 116th St. and Harvard Ave. to The Austin Co., 16112 Euclid Ave. Estimated cost $200,000.

**O., Cleveland**—Chain Products Co., F. G. Hodell, Pres. and Treas., 3924 Cooper Ave., awarded contract for the construction of a 1 and 2 story, 26 x 70 ft. factory to A. M. Higley Co., Plymouth Bldg. Estimated cost $40,000.

**O., Cleveland**—Hammond Mfg. Co., C. M. Allen, Pres., 7808 Kinsman Rd., awarded contract for the construction of a 1 story, 75 x 124 ft. factory at 3889 East 80th St. to R. E. Nixon, 10006 Carnegie Ave. Estimated cost $50,000.

**Pa., Altoona**—Dixon Motor Co. Inc., F. Dixon, Mgr., 2507 Beale Ave., will build a 1 story, 120 x 225 ft. automobile truck manufacturing plant between 8th and 9th Aves. Estimated cost $90,000. Private plans. Work will be done by day labor.

**Pa., Connellsville**—Capstan Glass Co., awarded contract for a 1 story, 150 x 340 ft. carton glass factory to The Austin Co., Union Trust Bldg., Pittsburgh.

**Pa., Donora** — American Steel & Wire Co., Rockefeller Bldg., Cleveland, O., awarded contract for excavation and foundation work for the construction of a steel mill including two rod mill buildings, billet storage, etc. to Donora Construction Co., First and Second Sts. Estimated cost $5,000,000.

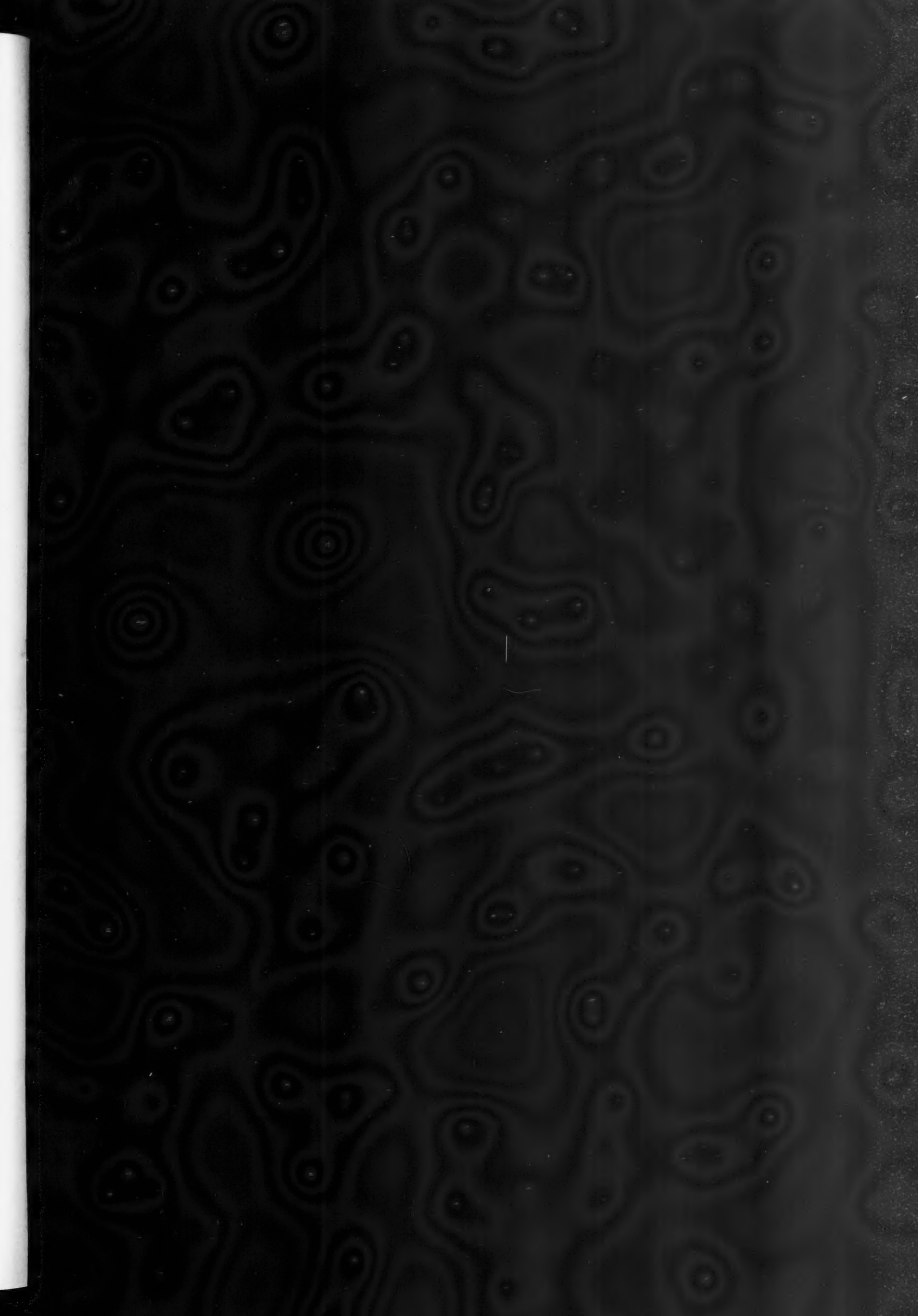
**Pa., Erie**—General Electric Co., J. Wright, East Lake Rd., awarded contract for the construction of a 1 story, 75 x 225 ft. factory to J. C. Hammond, 405 Ariel Bldg.

**Pa., Meadville**—Hookless Fastener Co., L. Walker, Pres., East Arch St., will soon receive bids for the construction of a 3 story, 50 x 70 ft. factory. Wilbur Watson & Associates, 4614 Prospect Ave., Cleveland, O., are architects and engineers.

**Pa., Neville Island**—The American Tubular Elevator Co., 4700 Second Ave., Pittsburgh, awarded contract for the construction of a 1 story, 65 x 180 ft. factory on Grand Ave. here to Uhl Construction Co., 115 5th Ave., Homestead. Estimated cost $40,000.

**Tex., Houston**—Midwest Piping & Supply Co., Inc., 1450 South Second St., St. Louis, Mo., plans the construction of a factory for the fabrication of large piping at Bringhurst and Cline Sts. here. Estimated cost $250,000.

**Wash., Seattle**—Liquid Carbonic Corp., Lloyd Bldg., awarded contract for a 2 story, 150 x 180 ft. factory at 5021 Colorado Ave., to The Austin Co., Dexter Horton Bldg. Estimated cost $75,000.

**Ont., Mount Dennis**—F. N. Burt & Co., 330 Bay St., Toronto, awarded contract for the construction of a 1 story, 175 x 350 ft. stationery manufacturing plant here, to Dickie Construction Co., 17 Yorkville Ave., Toronto. Estimated cost $150,000.

**Ont., St. Catherines**—W. S. Tyler, West 36th St. and Superior Ave., Cleveland, O. (ornamental iron and bronze) is having plans prepared for the construction of a factory, here. Estimated cost $150,000. G. S. Rider Co., Marshall Bldg., Cleveland, is architect.